

CORRECTIVE MEASURES STUDY REPORT
FOR
PECHINEY PLASTIC PACKAGING, INC. FACILITY
1500 EAST AURORA AVENUE
DES MOINES, IOWA

Prepared for


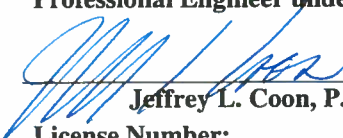
PECHINEY PLASTIC PACKAGING, INC.
DES MOINES, IOWA

Project No. 1912623.0101

July 2006

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RCRA RECORDS

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SECTION 1

INTRODUCTION

1.1 OBJECTIVE

Pechiney Plastic Packaging, Inc. (PPPI) (formerly American National Can Company [ANCC]) and the U.S. Environmental Protection Agency (EPA), Region VII, entered into an Administrative Order on Consent (Consent Order) (Docket No. VII-91-H-0021) to conduct a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the PPPI facility in Des Moines, Iowa. The RFI work efforts were documented in the July 2002 RFI Report. A Focused Baseline Risk Assessment (Focused BIRA) to evaluate the risks associated with soil and groundwater contaminants identified at the PPPI facility was completed in June 2003. This Corrective Measures Study (CMS) Report, prepared by MWH on behalf of PPPI, summarizes historical investigation and remedial activities conducted at the PPPI facility, evaluates corrective measures to address contamination, and provides a recommendation for site closure.

1.2 SITE BACKGROUND

1.2.1 Facility Location

The PPPI facility is located at 1500 East Aurora Avenue in Des Moines, Iowa, as shown by Figure 1-1 (from the July 2002 RFI Report).

1.2.2 Facility History

Prior to 1946, the property was used as a dairy farm. In 1946, Luthe Hardware Company purchased the property and constructed a warehouse for the temporary storage of wholesale hardware goods (1946-1947). Luthe Hardware Company utilized the warehouse until 1957, at which time the facility was leased to Ford Motor Company (Ford). Ford operated the facility as a parts warehouse and regional sales office until 1964.

In 1964, American Can Company leased the property from Luthe Hardware Company for use as a flexible packaging facility. Manufacturing equipment was moved into the facility between 1964 and mid-1965, and manufacturing operations commenced in mid-1965. ANCC purchased the facility from Luthe Hardware Company in 1988.

1.2.3 RCRA History

On or about August 6, 1980, American Can Company submitted to the EPA Region VII a Notification of Hazardous Waste Activity for the Des Moines, Iowa facility, pursuant to Section 3010 of the RCRA, 42 USC 6930. American Can Company identified its activities as a generator of and treatment, storage and disposal facility for hazardous wastes D001, D007, D008, F003 and F005, as identified in 40 CFR 261.21, 262.24 and 262.31, respectively. American Can Company was issued EPA ID No. IAD001818327.

On or about November 14, 1980, American Can Company submitted Part A of the RCRA hazardous waste permit application for the facility and qualified for interim status pursuant to Section 3005(e) of RCRA, 42, USC 6925(e). In its Part A application, American Can Company identified its hazardous waste management activities as storage of hazardous waste identified as F003 and F005 in one 10,000-gallon aboveground tank and container. The wastes identified were from printing and laminating operations and ink and adhesive sludges. American Can Company revised its Part A application on or about September 15, 1981 to identify storage of hazardous wastes F003, F005, D001, D007, and D008 only in containers.

On or about June 9, 1982, the EPA Region VII approved the Part A interim status modification which had been requested on or about September 15, 1981.

In a letter dated July 15, 1983, the EPA Region VII requested that American Can Company submit a copy of Part B of its hazardous waste permit application. On January 6, 1984, American Can Company informed the EPA of its decision not to complete the Part B permit application and stated its intention to operate only as a generator of hazardous waste.

In a letter dated July 30, 1984, the EPA Region VII notified American Can Company of its tentative decision to deny a RCRA permit and terminate interim status at the facility. A public notice of this decision was issued on August 3, 1984.

On September 26, 1984, the EPA Region VII officially denied a RCRA hazardous waste permit and terminated interim status at the American Can Company facility, in accordance with Section 3005 of RCRA, 42, USC 6925. Pursuant to 40 CFR 124.15, the termination of interim status became effective 30 days thereafter, on October 26, 1984.

On April 24, 1987, American Can Packaging Company notified the EPA Region VII that, on or about April 30, 1987, American Can Packaging Company, a wholly-owned subsidiary of Triangle Industries, Inc., would merge with National Can Corporation, another wholly-owned subsidiary of Triangle Industries, Inc. The resulting corporation would change its name to American National Can Company.

On or about July 31, 1991, the EPA Region VII issued an Administrative Order on Consent, Docket No. VII-91-H-0021 to PPPI for the Des Moines, Iowa facility. The Administrative Order was issued under Section 3008(h) of RCRA and as part of the "lead initiative." The lead initiative was a multi-media effort by the EPA to target lead contamination. The intent of the Administrative Order was that interim measures, investigations, and studies required by the Administrative Order be implemented by PPPI.

As part of the Administrative Order requirements to be fulfilled by PPPI, a "Description of Current Conditions" (DCC) document and a RFI Work Plan (August 1991 RFI Work Plan) were submitted to the EPA Region VII in August 1991. In a September 15, 1992 letter to PPPI, the EPA Region VII provided comments on the DCC document and the August 1991 RFI Work Plan.

In November 1992, a revised DCC document and RFI Work Plan were submitted to the EPA Region VII. The revised documents addressed the comments from the September 15, 1992 letter to PPPI and provided necessary background information to ensure all appropriate areas of concern at the PPPI facility were addressed in the RFI process. On August 31, 1993, Montgomery Watson received comments to the November 1992 RFI Work Plan from the EPA, Region VII. The comments addressed minor inconsistencies within the RFI Work Plan. On September 3, 1993, PPPI, Montgomery Watson and EPA Region VII personnel met in Des Moines to discuss each comment and reach a general agreement on how each comment would be addressed in an Addendum to the November 1992 RFI Work Plan. An Addendum to the November 1992 RFI Work Plan was forwarded to the EPA Region VII on September 13, 1993. The Addendum to the November 1992 RFI Work Plan was approved by the EPA Region VII on September 20, 1993 in a Notice of Approval with Modifications.

Investigation activities at the PPPI facility commenced on October 18, 1993.

On April 4, 1994, a letter report on RFI Activities was submitted to the EPA to briefly summarize preliminary data of the RFI work performed at the PPPI facility. The report included a review of the work conducted at the facility and the data collected at that point. Recommendations for additional work at the site, based on the data presented, were also included. Additional drilling, soil and groundwater sampling, and monitoring well installation activities outlined in the April 4, 1994 letter report on RFI activities for the facility commenced on May 9, 1994.

On September 19, 1994, a letter report on RFI Activities was submitted to the EPA to briefly summarize preliminary data of additional RFI activities performed at the PPPI facility. Included was a review of the work completed from May through mid-August 1994 along with data collected during the additional RFI activities. Recommendations for further action were also included.

Residual soil contamination above the water table was removed from the former burn pit area in late October and early November 1999.

The RFI Report was submitted to the EPA in February 1995, with revisions submitted in November 1999 and July 2002. The EPA approved the RFI Report on December 4, 2002.

A 2001 Sampling Report was submitted to the EPA on February 6, 2002. The EPA provided comments in a letter dated June 3, 2002. The Final 2001 Sampling Report and Addendum to Final RFI Report was issued on July 10, 2002.

The June 3, 2002 letter from the EPA requested a Focused BIRA be conducted. A proposed scope was submitted to the EPA on November 5, 2002. EPA provided comments on the proposed scope in a letter dated November 27, 2002, to which PPPI responded on December 18, 2002. A Draft Focused BIRA was submitted to the EPA on February 20, 2003; comments from the EPA were issued March 6, 2003. A response to comments and a red-lined version of the Draft Focused BIRA were submitted to the EPA on April 17, 2003. The EPA approved the Draft

Focused BIRA on May 14, 2003; the Final Focused BIRA was submitted to the EPA on June 30, 2003.

In a letter to PPPI, dated March 3, 2006, the EPA provided comments on the July 2003 CMS Summary Report. The EPA recommended the CMS Summary Report be revised to include criteria used to evaluate corrective measures studied at the facility.

1.3 SITE DESCRIPTION

1.3.1 Site Features

The PPPI facility generally consists of a large manufacturing building and associated offices surrounded by paved parking areas and outer storage areas and buildings.

1.3.2 Site Geology

Boring log data obtained from site drilling activities indicate the geology of the PPPI site consists of a variably interbedded mixture of fill, silty clay, sands, and gravel overlying the regional Wisconsinan drift and Beaver Channel sand and gravel deposits. In the northeast area, the uppermost soils are composed predominantly of silt, clayey silt and fine to medium sand. The upper soils in the Southwest Area appear to be more composed of fill materials (sand and gravel, fine-coarse fill sand, rubble) overlying rust-colored silty clay. The highly variable nature of the surficial deposits makes site-wide correlations of these deposits between the two areas difficult.

Underlying the upper surficial deposits at both areas of the site, dense, gray to brown gray, silty clay to loam Wisconsinan basal till is encountered. The upper 5 to 15 feet of till appears locally oxidized and weathered. Compared with the upper soil deposits, the till is denser and contains less percent moisture and porosity. Thin, poorly sorted, apparently discontinuous sand and sand and gravel seams are occasionally present within the till. The thickness of the till is approximately 45 feet. The Beaver Channel deposits encountered at a depth of approximately 53 feet consist of gray, fine to coarse, sand and sand and gravel materials. The Beaver Channel sand and gravel deposit is at least 35 feet thick at the site; the entire thickness of this unit and the depth to bedrock has not been determined at the site.

1.3.3 Site Hydrogeology

1.3.3.1 Depths to Groundwater and Groundwater Surface Elevations. Monitoring wells at the PPPI facility were gauged on October 3, 1989; October 21, 1991; November 30, 1993; December 14, 1993; January 3, 1994; June 17, 1994; August 18, 1999; September 30, 1999; August 7, 8, and 9, 2001; and November 12, 13, and 14, 2001. In general, groundwater levels in the shallower wells installed in surficial materials range from approximately 2 to 11 feet below ground surface, whereas water levels in the deeper wells installed in Wisconsinan till range from approximately 14 to 26 feet below ground surface. Temporal and seasonal variations of shallow groundwater levels are strongly controlled by infiltration, which is directly related to the recent precipitation history. Lower groundwater elevations typically occur during dry periods and periods of frozen ground (which restricts infiltration), often during the winter months.

1.3.3.2 Groundwater Flow Patterns. Site groundwater flow patterns in both the shallow surficial materials and deeper Wisconsinan till unit are well documented by the several groundwater gauging events completed during the course of the project. The primary components of both shallow and deeper groundwater flow are generally oriented in similar directions and do not appear to fluctuate significantly in response to seasonal changes. Typical groundwater flow is shown in Figures 4-M and 4-N (from the July 10, 2002 Final 2001 Sampling Report and Addendum to Final RFI Report).

1.3.3.2.1 Surficial Materials

The predominant direction of horizontal groundwater flow in the surficial materials in the northeastern portion of the site is variably directed toward the northwest, north, and/or northeast, with a groundwater high consistently in the area northeast of the facility and a groundwater low consistently in the low area north of railroad spur. Shallow groundwater flow in the northeastern area is strongly controlled by lower topography to the north and northeast of the facility, and the localized and temporary ponding of surface runoff that occurs east and northeast of the facility.

The predominant direction of horizontal groundwater flow in the surficial materials in the southwestern portion of the site is consistently directed toward the southeast, south, and southwest, with a groundwater high generally occurring within one of the northernmost tier of monitoring wells and a groundwater low consistently occurring to the south. Shallow groundwater flow is strongly controlled by higher topography to the west and northwest of the facility (creating components of flow toward the south and southeast), and a higher facility floor elevation roughly 2 to 4 feet above street level to the south (creating components of flow toward the southwest).

1.3.3.2.2 Wisconsinan Till

The direction of horizontal groundwater flow in the Wisconsinan till in the northeastern portion of the site is consistently directed toward the northwest, with a groundwater high consistently in the area northeast of the facility and a groundwater low consistently in the low area north of the railroad spur.

The direction of bulk horizontal groundwater flow in the Wisconsinan till in the southwestern portion of the site cannot be determined using data from only two monitoring wells installed in this area. However, groundwater flow vectors have been consistently directed toward the south and east.

Similar to shallow groundwater flow, groundwater flow in the deeper Wisconsinan till appears to be indirectly controlled by the surface features; however, to a lesser, more subdued degree. There is a lag between when the surficial hydraulic effects are transmitted into the shallow surficial materials and subsequently to the deeper, less conductive till.

1.3.3.3 Hydraulic Gradients.

1.3.3.3.1 Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were calculated for several monitoring well pairs in the surficial materials in both the northeastern and southwestern areas of the site, and for the Wisconsin till in the northeastern area. The horizontal hydraulic gradients in the surficial materials in the northeastern area ranged from approximately 0.0015 within the grassed area east of the facility in November 1993, to 0.025 between the grassed area east of the facility and the low area to the northwest in August 1999. The horizontal hydraulic gradients generally are larger following significant precipitation events as infiltration is occurring.

The horizontal hydraulic gradients in the surficial materials in the southwestern area have been consistently between 0.02 and 0.04 for the various gauging events and do not appear to be as strongly affected by precipitation events as the northeastern area.

The horizontal hydraulic gradients in the Wisconsin till for the gauging events in 1993 and 1994 were consistently about 0.035. The horizontal hydraulic gradients in the till for the two 1999 gauging events were higher at approximately 0.06 following a precipitation event.

1.3.3.3.2 Vertical Hydraulic Gradients

Vertical hydraulic gradients were calculated for several of the well clusters for several gauging events. The calculated vertical gradients ranged from approximately 0.006 to approximately 0.8 (downward).

1.3.3.4 Hydraulic Conductivities. Hydraulic conductivity (K) values determined for soils present above the Wisconsin till generally range on the order of 10^{-4} feet per minute (ft/min), whereas the K values for the till are generally two orders of magnitude lower at 10^{-6} ft/min. The Iowa Department of Natural Resources specifies a site as a "protected groundwater source" if a measured K value exceeds 0.44 meters per day (approximately 10^{-3} ft/min). The highest K value determined at the site was 5.7×10^{-4} ft/min, which is approximately equivalent to 0.25 meters per day. Because the highest K value at the site is less than 0.44 meters per day, the site is considered a "non-protected groundwater source."

1.3.3.5 Conceptual Hydrogeologic Model. In general, a conceptual hydrogeologic model of vertical groundwater flow in the northeast and southwest areas of the site suggests lateral groundwater flow likely occurs in the upper soils above the Wisconsin till and is assumed to occur in the productive Beaver Channel sand and gravel aquifer underlying the till. Groundwater flow through the dense till is essentially vertical, with a slight horizontal component of flow. Based on this conceptual depiction, the till provides a thick confining unit between the shallow groundwater above the till and the regional aquifer of the Beaver Channel. The conceptual vertical flow system is consistent with the results of slug tests, which indicate a large difference in K between the two units.

The horizontal hydraulic gradients within the surficial materials are roughly one to two orders of magnitude smaller than the vertical hydraulic gradients between the surficial materials and the till; however, the calculated horizontal hydraulic conductivities in the surficial materials are roughly one to two orders of magnitude larger than in the till. Furthermore, the vertical hydraulic conductivity of the till are expected to be one to two orders of magnitude smaller than the horizontal hydraulic conductivity of the till due to the clayey nature of the till and preferential laminated orientation of clay minerals in the till. Therefore, even though the vertical hydraulic gradients are directed downward, which suggests the potential for hydraulic connection between the surficial materials and the till, net vertical groundwater movement to, and within, the till are likely one to two orders of magnitude smaller than the horizontal groundwater movement in the surficial materials.

SECTION 2

SITE INVESTIGATION AND REMEDIATION

This section is organized according to specific areas within the northeast and southwest sections of the site. Specific areas are shown in Figure 1.

2.1 NORTHEAST AREA

2.1.1 Soil Investigation

2.1.1.1 Printing Ink Residue Area. Initial sampling conducted at the printing ink residue area in 1986 indicated elevated levels of lead, chromium and volatile organic compounds (VOCs). Soils containing printing ink residues subsequently were excavated in April 1989. Due to remaining elevated lead concentrations, an additional 6 to 8 inches of soil were removed from the area, with further soil removal required near the southeast corner of the excavation. Analysis of soil samples following excavation activities indicated target analytes were below proposed hazardous constituent levels. Target VOCs (toluene, 1,1,1-trichloroethane and trichlorofluoromethane) were not detected in soil samples, and metals, lead and chromium, were found below 500 milligrams per kilogram (mg/kg) and 1,000 mg/kg, respectively. Further sampling in October 1993 during RFI activities further confirmed metal concentrations consistent with background concentrations established for the site, and VOC and base-neutral acid (BNA) concentrations equal to or below quantitation limits.

2.1.1.2 Former Burn Pit Area. Soil sampling activities in the former burn pit area were first conducted during RFI activities in October 1993 and May 1994 to determine the magnitude and extent of soil contamination. Soil samples were analyzed for metals, VOCs, and BNAs. Metals were detected above background levels in nearly all soil borings installed in the former burn pit area. Lead, chromium, and barium were generally detected at the highest concentrations in soil samples collected from the 0- to 1-foot and 2- to 3-foot intervals, with elevated concentrations of lead and chromium primarily located in the northwestern and southwestern portions of the former burn pit/area. VOCs detected in the area consist primarily of benzene, toluene, ethylbenzene and xylenes (BTEX), although other VOCs such as trichloroethane, acetone, methyl ethyl ketone (MEK), 1,1,2,2-tetrachloroethene, and 1,1,1-trichloroethane were also detected. The extent of VOC contaminated soils in the former burn pit area was primarily restricted to the northern portion of the area. The most common BNA detected in the area was bis (2-ethylhexyl) phthalate; other BNA compounds detected include 4-methyl phenol (p-cresol), phenol, benzyl butyl phthalate, di-n-octyl phthalate, N-nitrosodi-n-propylamine, and 3,3-dichlorobenzidine. The extent of BNA contamination appeared to be restricted to the approximate limits of the former burn pit area. BNAs were not detected in any other soil samples collected at the PPPI site. Residual soil contamination above the water table was removed from the former burn pit area in late October and early November 1999.

2.1.1.3 Former Container Storage Area. The former container storage area was used to store containerized wastes, and consisted of a soil pad in the northern part and a concrete pad in the

southern half. Initial sampling was conducted in 1984 and 1986, with the primary constituents of concern detected in this area including lead and chromium, although low levels of VOCs also were found. Additional soil samples were collected in September 1989 for analysis of VOCs, lead, and chromium. VOCs were not detected in any of the soil samples; lead and chromium were detected in one soil sample at the northwest corner of the soil pad. In October 1989, the concrete portion of the former container storage area was decontaminated and removed. Soil from beneath the concrete pad was sampled and analyzed for VOCs, lead, and chromium. VOCs were not detected in any soil samples, while lead and chromium were detected above proposed cleanup levels of 500 mg/kg and 1,000 mg/kg, respectively, in some soil samples. Six inches of soil were excavated, and additional soil sampling was conducted in November 1989. Lead concentrations again were detected above proposed cleanup levels; therefore, in January 1990, an additional 8-inch layer of soil was removed from the former container storage area. Laboratory results from soil sampling conducted following the January 1990 excavation showed lead and chromium concentrations below 50 mg/kg and 29 mg/kg, completing closure activities for the former container storage area. Further sampling in October 1993 during RFI activities further confirmed metal concentrations consistent with both background levels and the residual levels of lead and chromium remaining in this area following closure activities; VOCs and BNAs were not detected.

2.1.1.4 Former Buried Drum Area. Slightly elevated concentrations of chromium and lead were detected at shallow depths in soil samples collected from the vicinity of the former buried drum area in June of 1989, during construction of the north building addition. On November 29, 1989, two buried 55-gallon drums were unearthed during installation of a new water main for a fire sprinkler system east of the north building addition. The drums were found at a depth of approximately 3 feet atop an underground concrete slab and contained approximately 40 gallons of a thick viscous liquid assumed to be press oil. No other drums were unearthed during excavation activities in this area. The drums and surrounding soil were removed from the excavation and temporarily stored on site for later disposal at an off-site location. Analytical results for the drum material and excavated soil detected the presence of toluene. For confirmation purposes, further sampling was conducted in October 1993 to fully characterize the soil in the area and to provide assurance that additional drums were not buried. Soil samples were collected and analyzed for metals, VOCs, and BNAs. Chromium and lead were detected above background concentrations in some samples. Although toluene was detected at a high concentration in the approximate vicinity of the drums removed in 1989, the concentration of toluene in soil had declined significantly since the drum removal activities conducted in 1989. Acetone, MEK, and xylenes were not detected at concentrations greater than 303 micrograms per kilogram ($\mu\text{g/kg}$), and VOCs were not detected above quantitation limits. BNAs were not detected in any soil samples collected in the former buried drum area.

2.1.1.5 Former Bulk Tank Area. The bulk tank was located northeast of the original plant building and was used to store solvents and ink sludges transferred from the plant area by the former portable tote bin. The area contained a 10,000-gallon bulk storage tank surrounded by an earthen berm enclosing an area of about 400 square feet. Initial sampling in the vicinity of the bulk tank area detected the presence of slightly elevated lead concentrations. The tank was removed in 1981, and closure of this area was completed in accordance with a submitted closure plan approved by the Iowa Department of Environmental Quality in 1984. Two surface soil

samples were collected in the bulk storage tank area in 1986 and analyzed for VOCs, extractable lead, and chromium. VOCs were not detected in the soil samples, and extractable lead and chromium were found in one soil sample at 0.07 mg/kg and 0.54 mg/kg, respectively. Currently, the bulk storage area is paved over with asphalt for a parking area, and there is no evidence of former hazardous waste storage activity.

2.1.2 Groundwater Investigation

Initial groundwater sampling was conducted in 1986 and 1987, with subsequent sampling events in June, August, and October, 1989; October 23, 1991; December 1, 2, and 3, 1993; May 10, 1994; June 16 and 17, 1994; August 19, 20, 23, and 27, 1999; August 7, 8, and 9, 2001; November 12, 13, and 14, 2001; August 14, 15, and 16, 2002; and November 4, 5, and 6, 2002. Groundwater analytical data is provided in Table 2-1 (the amended Table 6-3A from the July 10, 2002 Final 2001 Sampling Report and Addendum to Final RFI Report).

Results consistently indicate elevated lead concentrations in the former burn pit area, which are likely the result of soil contamination. Elevated arsenic concentrations in groundwater may be the result of contamination associated with the former burn pit, the printing ink residue, or the former container storage areas. An elevated nickel concentration was observed in a deeper monitoring well in the former bulk tank area; nickel was not detected in any other wells above the Maximum Contaminant Level (MCL) in the northeast area of the PPPI site.

Elevated concentrations of acetone, MEK, and BTEX were observed in the former burn pit area and north of the printing ink residue area. The horizontal extent of this VOC contamination appears to be limited to an area of about 100-150 feet north and northeast of the former burn pit area. The orientation of the VOC plume is consistent with the direction of shallow groundwater flow determined in this area. Other VOCs detected in the northeast area include chloroethane, 1,1-dichloroethene, 1,1-dichloroethane, 1,3-dichlorobenzene, and 1,4-dichlorobenzene. No VOCs were detected in the deeper monitoring wells in the northeastern portion of the site, indicating the vertical extent of VOC contamination is confined to the uppermost sediments located above the clayey Wisconsin till.

BNA compounds, including 2,4-dimethylphenol, 2-methylphenol, 4-methylphenol, phenol, and di-n-butyl phthalate, were detected at low concentrations in groundwater samples collected in the vicinity of the former burn pit area. No other BNAs were detected in groundwater samples from the northeast area.

2.2 SOUTHWEST AREA

2.2.1 Soil Investigation

2.2.1.1 Former Concrete Sump Drain Accumulation Tank Area. The sump drain accumulation tank was a 300-gallon underground sump constructed of concrete located near six underground product storage tanks south of the plant building. The sump tank was connected, by piping, to floor drains inside the plant building to collect spills and/or wash water from spills within the manufacturing area. Initial soil sampling activities conducted near the sump drain

tank were focused on the underground storage tanks (USTs) located immediately north of the sump area. Analytical results did not indicate the presence of VOCs or alcohols above quantitation limits, and lead and total chromium were detected below concentrations of concern. Soil samples were not collected from the base of the sump tank, which was located at a depth of approximately 10 feet. The sump drain accumulation tank was removed in June 1990. Because the excavation was backfilled with native soil following removal of the sump tank, surface soil samples were not targeted for collection in this area. In the fall of 1993, during RFI activities, one soil boring was drilled through the center of the backfilled former sump drain tank location, below the bottom of the former excavation. VOC, alcohol, and acetate concentrations all were below quantitation limits.

2.2.1.2 Former UST Area #2. The former UST area #2 was located south of the facility and contained four 5,000-gallon and two 1,500-gallon USTs used to store toluene, isopropyl alcohol, ethyl alcohol, propyl acetate, and hexane-based solvents. In April 1990, five soil borings were installed around the perimeter of the former UST area #2 to determine whether contamination was present in the surrounding soils. Analytical results did not indicate the presence of VOCs or alcohols above quantitation limits, and lead and total chromium were detected below concentrations of concern. The USTs were excavated and removed in June 1990, and soil samples were collected below each UST at the bottom of the excavation. Lead and chromium were detected at levels considered representative of background concentrations. N-propanol was detected in the soil samples below two of the tanks at 48 $\mu\text{g/kg}$ and 6.4 $\mu\text{g/kg}$, respectively, both considered nonhazardous. Isopropyl alcohol was detected in the soil sample below one tank at 11 $\mu\text{g/kg}$, also considered nonhazardous. VOCs were not detected above quantitation limits.

2.2.1.3 Fuel Oil Tank #1 Area. A 20,000-gallon fuel oil tank was installed south of the facility in June 1976 to store fuel oil for back-up generators in case of power failure. The tank subsequently has been drained and emptied. During the fall of 1993, four soil borings were installed around the perimeter of the fuel oil tank #1 area; VOCs and extractable hydrocarbons were not detected above quantitation limits. The fuel oil tank was excavated and removed on October 6, 1998.

2.2.1.4 Solvent Pipeline Spill Area. On March 12, 1990, a spill of 20 to 30 gallons of a liquid mixture of 90 percent n-propyl alcohol and 10 percent n-propyl acetate occurred from a broken pipe at a location between the former UST area #2 and the building. During the fall of 1993, one soil boring was drilled in the vicinity of the pipeline spill to determine the magnitude and vertical extent of the release. Soil sampling results indicated alcohol and acetate concentrations below detection limits.

2.2.2 Groundwater Investigation

Initial groundwater sampling was conducted in 1986, with subsequent sampling events in 1987; 1989; December 1, 2, and 3, 1993; June 16 and 17, 1994; August 19, 20, and 23, 1999; August 7, 8, and 9, 2001; November 12, 13, and 14, 2001; August 14, 15, and 16, 2002; and November 4, 5, and 6, 2002. Groundwater analytical data is provided in Table 2-2 (the amended Table 6-3B from the July 10, 2002 Final 2001 Sampling Report and Addendum to Final RFI Report).

Results indicated elevated arsenic concentrations in the solvent pipeline spill area and near the fuel oil tank #1 area; and elevated barium and nickel concentrations in the solvent pipeline spill area. The horizontal extent of the elevated metals concentrations appears to be limited to the solvent pipeline spill area and near the fuel oil tank #1 area. The source of the arsenic is unclear, as neither the solvent pipeline spill area nor the fuel oil tank #1 area is likely responsible for the elevated metals levels detected in groundwater samples.

Elevated concentrations of acetone, MEK, and BTEX compounds have been observed in the solvent pipeline spill area, although concentrations have decreased to below detection limits in recent samples. The horizontal extent of VOC contamination appeared to be limited. Other VOCs detected in the southwest area include cis-1,2-dichloroethene, 1,1-dichloroethane, 1,1,1-trichloroethane, and 4-methyl-2-pentanone. No VOCs were detected in the deeper monitoring wells in the southwestern portion of the site, indicating the vertical extent of VOC contamination is confined to the uppermost sediment located above the clayey Wisconsinan till.

No alcohol or acetate concentrations were detected in groundwater sampled from the southwest area monitoring wells.

2.2.3 Building Interior

RFI activities targeted the former portable tote bin, underground piping and floor drain/storm sewers for environmental sampling and analysis. These units are distinguished from the other solid waste management units (SWMUs) by their potential to release contaminants to the subsurface. The portable tote bin formerly was located outdoors and utilized over a 10-year period to accumulate wastes. The underground piping remains intact, underlying a portion of the facility, and may currently contain spilled waste or product from several other SWMUs. The floor drain/storm sewers are located beneath the facility and may convey spills or products to a discharge point located outside of the building. The remaining SWMUs, located within the building interior, are located aboveground and are isolated from the subsurface by a specially constructed concrete pad (waste accumulation areas) or the concrete floor of the facility. The former UST area #1 was located below ground; however, when these tanks were removed in 1981 and transferred to the UST area #2, visual inspection during the removal did not reveal evidence of contamination.

2.2.3.1 Floor Drains/Storm Sewer Area. Floor drains located within the plant facility are connected to a facility storm sewer, with an 18-inch diameter overflow pipe that discharges onto the ground surface east of the plant. The potential exists for spills within the plant to reach the floor drains and discharge outside on the ground during periods of overflow conditions. Two soil borings were installed in October 1993 at the discharge location to determine whether or not releases from the plant have occurred in this area. Toluene was detected at a depth of 2 to 3 feet at a concentration of 21.8 $\mu\text{g/kg}$, and metals were detected at levels consistent with background concentrations. BNA concentrations were below detection limits.

2.2.3.2 Portable Tote Bin Area. A 100-gallon steel portable tote bin, located near the southwest corner of the facility, formerly was used for temporary storage of waste solvents and

waste inks. In 1981, the portable tote bin was removed. Since that time, an addition to the PPPI facility was constructed over the excavated concrete floor of the former portable tote bin area. The former portable tote bin area is currently located under manufacturing operations at the PPPI facility. Two shallow soil borings were drilled through the concrete in November 1993 to determine whether soil contamination indicative of a past release was present in this area. Acetone and toluene were detected at a depth of 0 to 1 feet at concentrations of 130 $\mu\text{g}/\text{kg}$ and 57.2 $\mu\text{g}/\text{kg}$, respectively, and metals were detected at levels consistent with background concentrations. BNA concentrations were below detection levels.

2.2.3.3 Underground Piping Area. The underground piping associated with the former sump drain accumulation tank remains intact beneath a portion of the plant facility. This piping may contain accumulated wastes from the still room, ink blending room, and the product storage rooms. The piping was plugged at the foundation of the plant building; however, the floor drains connected to this piping have not been plugged. Two soil borings were installed within the plant in November 1993; one located near the foundation of the building where the piping is plugged, and the second located approximately 50 feet along the length of the piping. The purpose of these soil borings was to determine whether a release of contaminants has occurred in this area. 1,2-Dichlorobenzene and 1,1,2,2-trichloroethane, were detected at concentrations of 6.3 $\mu\text{g}/\text{kg}$ and 6.4 $\mu\text{g}/\text{kg}$, respectively, near the foundation of the building at a depth of 0 to 1 foot. Metal and BNA concentrations were below detection limits.

2.2.3.4 Remaining Building Interior SWMUs. Based upon observations made during a visual site inspection conducted October 28, 1993, no sampling was conducted near parts washers #1, #2, #3, and #4; and in the solvent still area; the press area; the EGAN laminator area; the FMC laminator area; the waste oil and press sludge accumulation area; the waste ink accumulation area; the hazardous waste accumulation area for the laminators; and the lubricating oil, heat transfer fluid, and glycol mixtures accumulation area.

SECTION 3

RISK ASSESSMENT

A Focused BIRA was performed to evaluate exposure routes for contaminants of concern at the site and provide a basis for selection of a final remedy for the site. A copy of the Final Focused BIRA is provided in Attachment A.

3.1 CHEMICALS OF POTENTIAL CONCERN

The Focused BIRA was performed on benzene, arsenic, barium, and lead, analytes identified by the EPA as chemicals of potential concern (COPC). Groundwater and soil were evaluated, with the risk evaluation focused on groundwater data in the northeast area of the site, and soil data in the former buried drum area, also in the northeast area of the site. Each of the four COPCs was detected in the former buried drum area; arsenic, barium, and lead were detected in a number of soil samples; and benzene, arsenic, barium, and lead were detected in groundwater samples.

3.2 EXPOSURE ASSESSMENT

The land use in all four cardinal directions from the PPPI property is light industrial/commercial in nature. For this reason, the most likely receptors to use the PPPI property would be PPPI employees and contractors hired by PPPI. The potential for both soil and groundwater exposure was considered.

Exposure routes considered applicable for soil include incidental ingestion, dermal contact, and inhalation of fugitive dusts. Since benzene was not detected in soils, soil vapors were not evaluated. Although 1) the likelihood for significant surface soil exposure for PPPI employees is low, and 2) subsurface soil exposure would unlikely occur unless construction workers were contracted to perform intrusive work in the former buried drum area, both employee and contractor exposure were evaluated. Exposure for PPPI employees was conservatively evaluated, assuming the maximum concentrations from the surface soil samples (top 2 feet of soil); while exposure for construction workers was conservatively evaluated, assuming the maximum analyte concentrations from all depths above 10 feet below ground surface.

Exposure routes considered applicable for groundwater include ingestion, direct contact, and vapor inhalation. Currently, the PPPI facility and the surrounding area are supplied with municipal water, which is supplied from off-site sources. For this reason, it is highly unlikely exposure to the shallow contaminated groundwater would ever occur. However, as a conservative assumption, a hypothetical scenario was created to assess the risk associated with employee consumption of shallow groundwater, assuming a well was placed in the shallow aquifer. Under this scenario, the ingestion route of exposure was evaluated. A second potential groundwater exposure scenario was included to address construction worker exposure to groundwater in an excavation, with exposure pathways including direct contact, incidental ingestion, and vapor inhalation. Because construction workers would conduct excavation during only a short period of time and would use protection such as rubber boots to protect from getting

wet, this exposure pathway is handled qualitatively. Exposure for both PPPI employees and construction workers was conservatively evaluated assuming the maximum average concentration of an analyte among representative monitoring wells.

3.3 TOXICITY ASSESSMENT

The four COPCs have a range of toxicological effects depending upon the magnitude and duration of exposure. Benzene and arsenic are known human carcinogens and also can cause a range of noncancer type effects. Lead and barium are not known to be human carcinogens, but produce a variety of toxic effects depending upon the magnitude and duration of exposure.

3.4 RISK CHARACTERIZATION AND UNCERTAINTY ANALYSIS

3.4.1 Soil Health Risk Estimates

3.4.1.1 Employee. The Focused BIRA assumed a worker would be exposed to soil through incidental ingestion of surface soil, dermal contact with surface soil, and inhalation of fugitive dusts derived from wind erosion of surface soils. Based on these exposure conditions, noncancer type health risks associated with exposure to arsenic and barium would not be anticipated. In addition the cumulative cancer risk due to arsenic exposure was determined to be well below the highest cumulative cancer risk the EPA generally considers acceptable.

To assess risks to lead, a comparison to the EPA Region 9 industrial soil PRG (i.e., 750 mg/kg) was made to the maximum concentration of lead detected in surface soil. The maximum concentration of lead in surface soil was 167 mg/kg, which is well below the soil PRG; therefore, exposure to lead should not pose a health concern to employees.

Considering these above results, the residual concentrations of arsenic, barium, and lead in the former drum burial area should not pose a health concern to employees. Benzene was not detected in soil in this area.

3.4.1.2 Construction Workers. The Focused BIRA assumed a construction worker would be exposed to soil (either surface or subsurface) through incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dusts derived from disturbing soils during construction activities. Based on these exposure conditions, noncancer type health risks associated with exposure to arsenic and barium would not be anticipated. In addition the cumulative cancer risk due to arsenic exposure was determined to be less than the highest cumulative cancer risk the EPA generally considers a *de minimis* risk.

Risks to lead were assessed using the same approach that was used for employees. The maximum concentration of lead in any soil sample collected from the area was 715 mg/kg, which is below the industrial soil PRG; therefore, exposure to lead should not pose a health concern to construction workers.

Considering these above results, the residual concentrations of arsenic, barium, and lead in the former drum burial area should not pose a health concern to employees. Benzene was not detected in soil in this area.

3.4.2 Groundwater Health Risk Estimates

3.4.2.1 Employee. Under current conditions, the PPPI facility and the surrounding area is supplied by a municipal water distribution system; therefore, exposure to the shallow contaminated groundwater at the site does not occur. For this reason, the shallow groundwater does not pose a current health threat to employees.

The Focused BIRA assumed an employee would be exposed to shallow groundwater through ingestion of the water from an on-site drinking water well. Based on this exposure scenario, noncancer type health risks would be anticipated. In addition, the cumulative cancer risk due to groundwater exposure was determined to be well above the highest cumulative cancer risk the EPA generally considers acceptable. The primary chemical of concern is arsenic for both types of effects (i.e., cancer and noncancer).

To assess risks to lead, a comparison to the MCL for lead (i.e., 15 micrograms per liter [$\mu\text{g/L}$]) was made to the maximum average concentration of lead detected in shallow groundwater. The maximum average concentration of lead in shallow groundwater was 12 $\mu\text{g/L}$, which is below the MCL; therefore, exposure to lead would not be anticipated to pose a health concern to employees.

Considering these above results, the residual concentrations of arsenic in shallow groundwater would pose a concern under the hypothetical scenario if a drinking water well were constructed in the shallow aquifer in the northeast portion of the site. However, it is very unlikely this exposure pathway would ever be complete. The groundwater contamination is localized on site in a shallow zone that would unlikely be able to be used as a drinking water source. In addition, the site is in the City of Des Moines, Iowa where the municipality supplies drinking water.

3.4.2.2 Construction Worker. The risk associated with incidental exposure to groundwater during construction activities is addressed qualitatively herein. Exposure to groundwater seepage into an excavation could occur via incidental ingestion of groundwater, dermal contact with the groundwater, and inhalation of vapors for those chemicals such as benzene that are volatile. The amount of exposure through these pathways is considered to be insignificant since the time a worker would spend in a wet excavation would be anticipated to occur for only a matter of hours, while performing work in the excavation. In addition, workers may wear protective clothing to prevent exposure to the water in the excavation preventing dermal contact with the water. Also, based on Occupational Safety and Health Administration (OSHA) regulations, workers are not to be allowed to work in excavations with standing water. Therefore, if standing water occurs in an excavation, it must be removed or other construction methods utilized to avoid worker contact with the water. The benzene concentration of groundwater seeping into a trench would be expected to be low, so that benzene vapors would not be expected in the trench, as fresh air would dilute any benzene that would be volatilized from the groundwater. Because of the limited duration of exposure, and limited contact that would occur with any water in the excavation, this would minimize the magnitude of any potential exposure. Considering these conditions, construction worker exposure to groundwater is not anticipated to pose a health concern.

SECTION 4

EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

The purpose of this section is to evaluate corrective measure alternatives that could potentially be applied to the site in order to find the alternative that best provides: 1) overall protection to human health and the environment, 2) attains media cleanup standards, 3) controls the sources of releases, and 4) complies with standards for management of wastes. In this section four corrective measure alternatives are chosen for evaluation because of their potential to address the COPCs at the site. These four alternatives are also compared to a no action alternative, to provide a baseline for comparison with the other alternatives.

4.1 CORRECTIVE MEASURE ALTERNATIVES

The corrective measure alternatives discussed in this section are alternatives that are being evaluated from the date of the report forward, and do not include the corrective measures (other than some institutional controls) that have already been undertaken or discussed regarding this site.

4.1.1 No Action

The no action alternative involves taking no action to address the COPCs at the site. This includes no preparation of institutional controls, no groundwater monitoring, and no active remediation. The only action that would likely be taken is to abandon the existing monitoring wells at the site in accordance with Iowa Department of Natural Resources (IDNR) rules.

4.1.2 Institutional Controls

Institutional controls that would be feasible for the site would be in the form of some type of access restriction that would, when properly used and maintained, eliminate the risk of exposure to COPCs. Access restrictions consist of administrative and/or legal measures to limit exposure to contaminated groundwater, such as covenants and well drilling prohibitions. These restrictions are relatively low cost and can be effective.

A Declaration of Restrictive Covenants (Declaration) was prepared and implemented by PPPI in 2005 to ensure current and future owners of the PPPI property limit the risk of exposure to impacted groundwater at the site by prohibiting the installation of water supply wells. A copy of the Declaration is included as Attachment B. As indicated in the Declaration, the installation or use of water supply wells will be prohibited within the legal boundaries of the site.

Further protection is offered by Polk County Ordinance Number 49.3(11) (Ordinance), which restricts the permitting of nonpublic water supply systems, including nonpublic water supply wells, when a public water supply is readily available. The Ordinance has been accepted by the IDNR as a reliable institutional control for restricting well construction within identified areas of concern. A copy of the ordinance, as provided by the IDNR, is included in Attachment C.

Under a 28E agreement, the IDNR has delegated the authority to permit private water wells within Polk County to the Polk County Health Department (Department).

Based on the existence of a well developed public water distribution system in the immediate vicinity of the Site, the Department has certified in writing the unlikelihood that private water supply wells will be permitted within 500 feet of the Site property boundaries. A copy of the documentation regarding this matter between MWH and the Department is also included in Attachment C for reference.

In order to conform to the Uniform Environmental Covenants Act, which took effect in Iowa on July 1, 2005, an Environmental Covenant was prepared for the purpose of subjecting the property to certain activity and use limitations in accordance with specified terms and conditions and the provisions of Iowa Code Chapter 455I. This Environmental Covenant will update the Declaration, which was signed and notarized by PPPI in 2005. The Environmental Covenant defines that the PPPI property is subject to activity and use limitations for installing wells on the property and transferring the title of the property. Once it is approved by all parties, the Environmental Covenant will be signed and notarized by a representative of PPPI, the IDNR, and the EPA. A draft copy of this Environmental Covenant is included in Attachment D.

4.1.3 Extraction and Treatment with Institutional Controls

The institutional controls presented in Section 4.1.2 above would be applied to the site in addition to groundwater extraction.

Contaminated groundwater could be extracted from wells located within the groundwater plumes and treated above the ground surface. Sufficient flow rates would be extracted to create a radius of influence that captures the groundwater plume. A pump test would be required to determine extraction well spacing and flow rates. Given the sandy soil at the site, pumps would likely be suitable to extract the water from each well. Water would be pumped above ground surface and treated using an air stripper. Air stripping involves mixing large volumes of air with water in a packed column or perforated trays to promote transfer of VOCs to air. Some metal COPCs would not be removed. These COPCs would be treated after air stripping, using liquid-phase granular activated carbon (GAC) adsorption. When the adsorption unit has exhausted its capacity, it would be removed and either disposed or regenerated. The use of GAC would likely require filtration of the water to remove suspended solids that could plug the GAC units or reduce their efficiency. It is assumed exhaust from the air stripper does not require treatment prior to discharge to the atmosphere; however, if required, options for this treatment include vapor-phase GAC, catalytic oxidation, or thermal oxidation. Treated water would be discharged under an National Pollutant Discharge Elimination System (NPDES) permit to a storm sewer or drainage ditch. The continued flushing and dissolution of COPCs from saturated soil into groundwater would eventually remediate both groundwater and saturated soils. Cost would depend upon a number of factors including the total number of wells required and effluent treatment requirements for air and water.

4.1.4 Chemical Oxidation with Institutional Controls

The institutional controls presented in Section 4.1.2 would be applied to the site in addition to chemical oxidation.

Chemical oxidation uses direct-push injected oxidizing agents (such as hydrogen peroxide, ozone, or potassium permanganate) to accelerate chemical transformation of VOCs and other contaminants into nonhazardous byproducts.

Contaminants dissolved in the groundwater and absorbed to saturated soil would be treated using direct-push application of the chemical oxidation reagents. Numerous oxidants are available; however, preliminary screening has determined that a sodium carbonate and multi-part catalytic formula combined product will be best suited for this site. The process begins with the injection of the catalytic formula through the direct-push rods. The catalyst consists of a proprietary formula that causes free radical oxidation when combined with the sodium carbonate. The sodium carbonate is then injected through the same injection rod to promote subsurface mixing of the catalyst and sodium carbonate. By-products of complete reactions would be water and carbon dioxide.

Reagents would be injected during two injection events separated by at least one month. The reason for this separation is because oxidants preferentially flow through certain channels in the soil matrix, leaving other areas of the soil matrix untreated before the oxidant is utilized (usually less than one day following injection). These untreated areas are also the reason the site is not sterilized and why microbial populations quickly rebound following treatment. The pause in treatment allows contaminants to migrate out of the nonpreferential flow areas and allows utilization of the “waste” oxygen for biodegradation. New injection points are then installed and the process is repeated. The new points result in new flow pathways and resulting treatment of additional soil. Although typically required, a third round of treatment is not always necessary.

In addition to multiple injection events, reagents would also be injected in multiple intervals at each injection location. This is completed because horizontal permeability is typically much larger than vertical permeability; therefore, the multiple intervals increases vertical distribution. Off-site migration of contaminated groundwater can occur because of the hydraulic forces resulting from the large volumes of solution injection. However, this is typically eliminated by treating perimeter/low concentration areas first. This provides an oxidizing zone through which any migrating groundwater must pass, destroying the COPCs.

The proposed chemical oxidant can address benzene, but will not likely address metals in the long-term. Arsenic may actually have increased mobility during and immediately following injection.

4.1.5 Oxygen Release Compound[®] with Institutional Controls

The institutional controls presented in Section 4.1.2 would be applied to the site in addition to the use of Oxygen Release Compound (ORC[®]).

The injection of ORC[®] product into the groundwater is a method of enhanced bioremediation, which accelerates the degradation of VOCs.

Solid ORC[®] is mixed with water to form a slurry. This slurry is direct-push injected in a grid pattern into the saturated zone within the contaminant plume. ORC[®] slowly releases oxygen into the groundwater over a period of up to one year. The oxygen migrates with groundwater flow throughout the soil matrix. This stimulates biological degradation of the hydrocarbons in the aqueous phase. Absorbed phase contaminant desorption and dissolution into groundwater is increased through enzymes released by the microorganisms. These contaminants are also then biologically degraded in the aqueous phase.

ORC[®] significantly increases the biological degradation rate of aerobically degradable contaminants, such as benzene; however, metals would not be addressed. Multiple injection events may be required to supply adequate oxygen over sufficient time to reach remedial goals; therefore, several years of treatment, followed by confirmation/rebound monitoring may be required.

4.2 COMPARISON OF CORRECTIVE MEASURE ALTERNATIVES

In order to base a decision on the best corrective measure for the site, the corrective measure alternatives, described in Section 4.1, are evaluated in Table 4-1 by comparing the five alternatives to the following factors:

- Long-term reliability and effectiveness.
- Reduction of toxicity, mobility, or volume of wastes.
- Short-term effectiveness.
- Implementability.
- Cost.

The following sections state the evaluation criteria that are briefly discussed for each factor in Table 4-1.

4.2.1 Long-Term Reliability and Effectiveness

This analysis evaluates long-term effectiveness with respect to the permanence of the alternative, whether the remedial goals are met, the magnitude of residual risk, and the adequacy and reliability of controls used to manage remaining waste over the long term.

4.2.2 Reduction of Toxicity, Mobility, or Volume of Wastes

The remedial alternative is evaluated in terms of its ability to reduce the principle threats at the site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. If applicable, this evaluation may include the type and quantity of residuals remaining after treatment.

4.2.3 Short-Term Effectiveness

This factor includes an evaluation of the effectiveness of an alternative in protecting human health and the environment during the construction and implementation, until the response objectives are met. This includes protection of the community, workers, and the environment. If applicable, the estimated time it takes to achieve remedial goals will be mentioned.

4.2.4 Implementability

The alternative is evaluated for the technical and administrative implementability and the availability of the goods and services needed to implement the alternative. Technical feasibility includes construction/operation, reliability, and ease of undertaking additional remedial action. Administrative feasibility encompasses activities that need to be coordinated with other agencies.

4.2.5 Cost

The alternative is evaluated in terms of its estimated present-worth costs, which may include capital costs, indirect costs, operation and maintenance costs, and review costs. Costs for site closure are likely to be the same for each alternative and, therefore, are not included. Detailed cost estimates for each alternative are presented in tables in Attachment E.

4.3 FINAL COMPARATIVE ANALYSIS AND THE RECOMMENDED CORRECTIVE MEASURE ALTERNATIVE

This section briefly compares the alternatives to four general standards of corrective measures in order to base a decision of a recommended alternative. The recommended alternative will be the one that best provides overall protection to human health and the environment, attains media cleanup standards, controls the sources of releases, and complies with standards for management of wastes.

4.3.1 Overall Protection of Human Health and the Environment

As explained in the Focused BIRA, the COPCs in the soil and groundwater at the site should not pose a health concern to employees and construction workers at the site. However, to provide assurance of short-term and long-term protection from the site's COPCs, the institutional controls presented in Section 4.1.2 should be applied to the site. The corrective action alternatives that involve active remediation (extraction and treatment, chemical oxidation, and ORC®) do not offer sufficient short-term and long-term protection on their own without institutional controls. Extraction and treatment will minimize off-site migration of contaminants and is not very effective in mass removal of contaminants. Chemical oxidation and ORC® will treat benzene, but will have no long-term effect to the metal COPCs. The no action alternative offers no protection since there are no controls to prevent exposure to COPCs.

4.3.2 Attain Media Cleanup Standards

As stated in Table 4-1, none of the corrective measure alternatives will attain media cleanup standards of all COPCs at the site. It is estimated that it may take up to 30 years of operating an extraction and treatment system and cost more than one million dollars to construct, operate, and

maintain in order to attain groundwater cleanup standards. In this case, the corrective measure that provides the best overall protection to human health and the environment should be the alternative that is implemented at the site.

4.3.3 Control the Sources of Releases

None of the corrective measure alternatives reduce or eliminate possible further releases of contaminants; however, institutional controls offers the best short-term and long-term protection to human health and the environment. The extraction and treatment alternative, by itself, also offers protection, but only in the sense that it prevents off-site migration of COPCs during system operation.

4.3.4 Comply with Standards for Management of Wastes

No wastes are handled during the institutional controls alternative. The extraction and treatment alternative will require coordination and permits with the IDNR for extraction wells, the local government for air emissions, and the local sewer utility for a water discharge permit. Federal and state laws will also need to be followed when disposing filter media. For the chemical oxidation and ORC[®] alternatives, a permit is required under the EPA's underground injection control program.

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

Investigation activities at the PPPI facility began in October 1993, and a thorough investigation has been conducted. The EPA identified benzene, arsenic, barium, and lead as COPCs at the PPPI facility and concurred the area with the greatest associated risk was the northeast area of the site, specifically the former buried drum area. The Focused BIRA evaluated groundwater data from the northeast area of the site and soil data from the former buried drum area. Results from the Focused BIRA indicated no risk associated with the soil in the former buried drum area. Although the Focused BIRA identified both noncancer and cancer risk associated with groundwater in the northeast area of the site, the risk resulted from hypothetical ingestion of impacted groundwater from an on-site drinking water well.

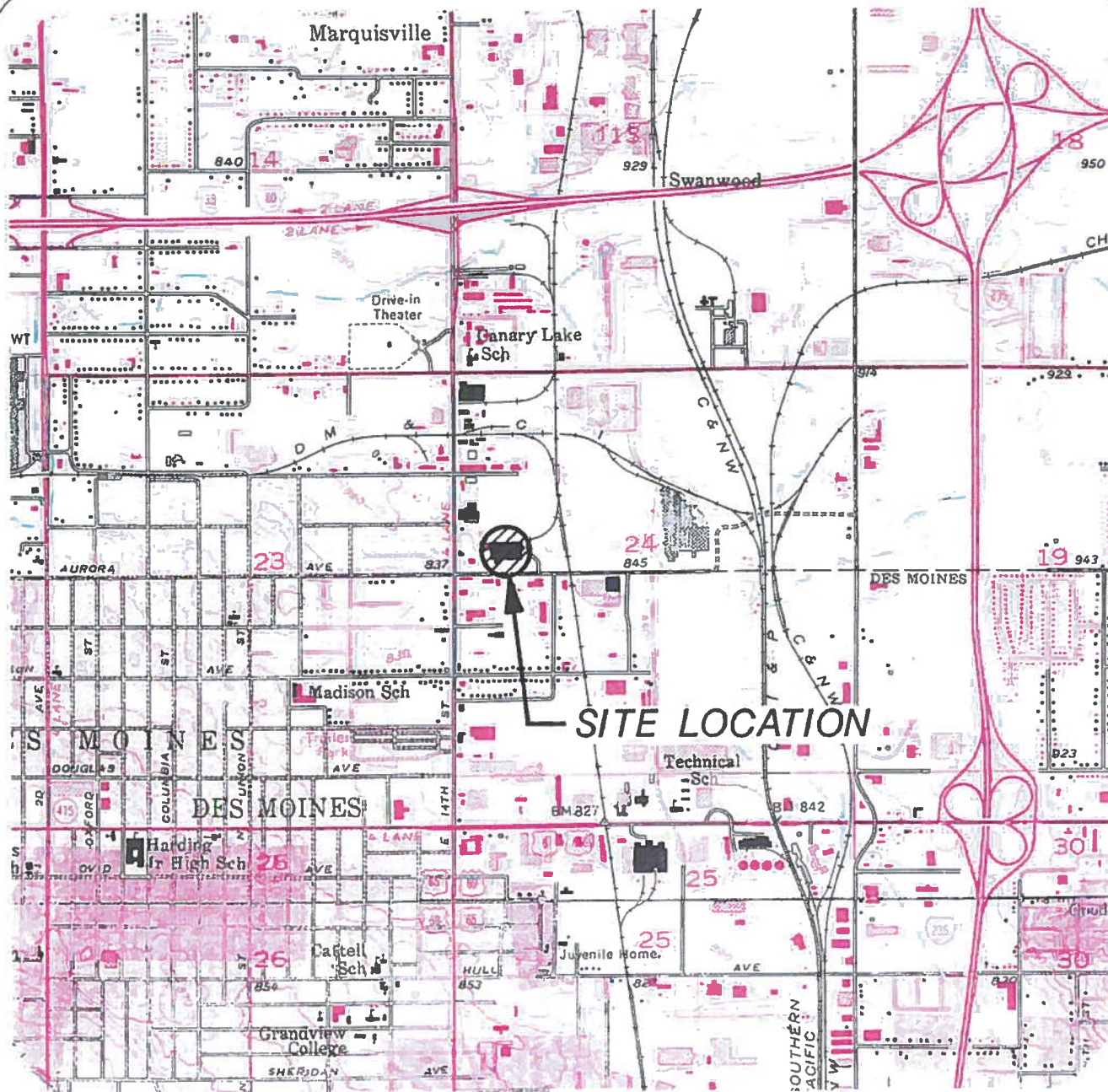
An evaluation was undertaken of several corrective measure alternatives that could potentially address the COPCs at the site. In this evaluation the alternatives were compared to several factors: long-term reliability and effectiveness; reduction of toxicity, mobility, and volume of wastes; short-term effectiveness; implementability; and cost. The alternatives were also compared to the following general standards for corrective measures: overall protection of human health and the environment, attain media cleanup standards, controls the sources of releases, and complies with standards for management of wastes. The comparison determined that institutional controls addresses the COPCs at the site just as well as active remediation with institutional controls, and at a much lower cost to implement.

The institutional controls that currently apply to the site are a Declaration that states PPPI will prohibit the installation of water supply wells at the site and an Ordinance, which restricts the permitting of nonpublic water supply systems, including nonpublic water supply wells, when a public water supply is readily available. An environmental covenant has also been prepared that will update the declaration of restrictive covenants. The purpose of the environmental covenant will be to subject the property to activity and use limitations for installing wells on the property and transferring the title of the property in accordance with specified terms and conditions and the provisions of Iowa Code Chapter 455I.

Installation of the on-site drinking water well is not probable because an existing municipal drinking water supply and distribution system is readily available. In the absence of an on-site drinking water installation, the groundwater exposure pathway would remain incomplete.

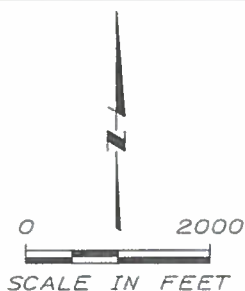
In conclusion, PPPI and MWH recommend no further action at the PPPI facility based on the following:

- The Focused BIRA indicated risk exposure to soil is low, and the groundwater pathway is not complete.
- Some institutional controls exist and another is being updated to prevent the installation of water supply wells on the property.



MAP SOURCE: U.S.G.S. TOPOGRAPHIC QUADRANGLES,
DES MOINES NE, AND DES MOINES SE, IOWA.

SITE LOCATION: SEC. 24, T. 79N., R. 24W.



MONTGOMERY WATSON

PECHINEY PLASTIC PACKAGING, INC.

SITE LOCATION MAP

FIGURE 1-1

June 27, 2003

Ms. Gayle Hubert
ARTD/RCAP, RCRA Branch
U.S. Environmental Protection Agency, Region VII
901 North 5th Street
Kansas City, KS 66101

MWH #2082521.0102

RE: Final Focused Baseline Risk Assessment
Pechiney Plastic Packaging, Inc. Site
Des Moines, Iowa

Dear Ms. Hubert:

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), MWH has prepared a Focused Baseline Risk Assessment (BIRA) for the PPPI site in Des Moines, Iowa. MWH has completed this Focused BIRA based on the Focused BIRA Work Plan that was submitted to the United States Environmental Protection Agency (USEPA) on November 5, 2002. In addition, this Focused BIRA addresses the two comments that were received from the USEPA on the Work Plan dated November 27, 2002. The comment response letter dated December 18, 2002 submitted by PPPI in regards to the USEPA Work Plan comments is provided as Attachment A to this Focused BIRA. On January 28, 2003 a teleconference between the USEPA and MWH was held to further clarify the requirements to address USEPA comment No. 2. The telephone log associated with this teleconference is also provided in Attachment A.

This letter Focused BIRA is broken into the following sections for ease of review:

- Project Background and Selection of Chemicals of Potential Concern
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization and Uncertainty Analysis

PROJECT BACKGROUND AND CHEMICALS OF POTENTIAL CONCERN

The BIRA is termed "focused" because the BIRA will be performed on specific analytes identified in the June 3, 2002 letter as contaminants of concern by the USEPA

(i.e., benzene, arsenic, barium, and lead). In addition, the USEPA specifically requested two media, groundwater and soil, be evaluated. Based on results of the RCRA Facility Investigation (RFI), and the Interim Removal Action (IRA) which occurred at the former burn pit area, the soil and groundwater risk evaluation was further focused. The approach presented in the Focused BIRA Work Plan was to limit the risk evaluation to the groundwater data in the northeast area of the site, and the soil data in the former buried drum solid waste management unit (SMU) of the same area. This is considered a conservative approach, since levels of residual contamination are highest in this particular area of the site. The rationale for this approach is further discussed in the Work Plan.

Thus based on the request from USEPA, four analytes were selected as chemicals of potential concern (COPCs) at the site, which included benzene, arsenic, barium, and lead.

EXPOSURE ASSESSMENT

An exposure assessment was performed to evaluate on a site-specific basis the ways by which people may potentially be exposed to the COPCs detected at the site. If complete exposure pathways are identified for people utilizing the site, then the magnitude of the potential exposure was assessed. The exposure assessment consisted of the following:

- A survey of land use in the area of the site.
- Soil and groundwater data was summarized and evaluated.
- A conceptual site model (CSM) was developed to evaluate the potential exposure pathways to specific receptors.
- The magnitude of chemical exposure for each selected receptor population was quantified.

The land use depicted on Figure 4-4 of the RFI Report was reverified on February 6, 2003. The land use in all four cardinal directions from the PPPI property is light industrial/commercial in nature. For this reason, the most likely receptors to use the PPPI property would be PPPI employees and contractors hired by PPPI. The nearest residential area is approximately 500 feet to the west of the PPPI facility.

The Focused BIRA addresses the four specific analytes (benzene, arsenic, barium, and lead) which were detected in soil at the former buried drum area. This area is located adjacent to the east side of the PPPI building and is approximately 10 feet by 50 feet. The other SMUs on site were not evaluated in the Focused BIRA because, based on the RFI,

contamination was not present in these areas, or has been remediated. The soil analytical data for the former drum burial area are summarized on Table 1. Benzene was not detected (i.e., <0.005 mg/kg) in any of the soil samples collected from the three soil boring advanced in this SMU. Arsenic, barium, and lead were detected in a number of the soil samples.

Within the northeast area of the site, where the former drum burial area is located, there is a monitoring well network that has historically been sampled numerous times (refer to Figure 1). The groundwater data for the northeast wells are summarized in Table 2 for the period of 1999 to present. The earlier data (i.e., prior to 1999) is not used in the risk assessment because it is considered old (i.e., 10 to 12 years old) and not representative of current conditions. Benzene, arsenic barium, and lead concentrations were detected in some of the monitoring wells. The few benzene concentrations detected and maximum arsenic concentrations were detected in monitoring well MW-3A located approximately 100 feet northeast of the PPPI building near the printing ink residue excavation area. Well MW-2B was found to be damaged during a sampling event and in 2001 the well was abandoned and a replacement well MW-2C was constructed approximately 5 feet from the original well. The 10-foot well screens for both these wells were set at approximately the same depth (approximately 50 feet below ground surface). Although the data from MW-2B is present in this table, the data from MW-2C is considered more representative of actual site conditions and was used in the Focused BIRA. It is believed that the turbidity of the groundwater in MW-2B which may have been due to internal damage of the well, resulted in the high metals concentrations that were detected in the well in 1999. For this reason, data from the well was not used in the Focused BIRA.

A similar situation occurred with monitoring well MW-6A. This well was located in the middle of an area that has been remediated since 1999. As part of the remediation this well was abandoned. For this reason, the 1999 monitoring data collected from the well was not considered representative of current site conditions, and was not used in the Focused BIRA.

Based on the land use characteristics of the site, and the chemical data for soil and groundwater, a conceptual site model was developed for the PPPI site for these two media. Table 3 presents the conceptual site model/exposure pathway analysis for the industrial land use scenario. As indicated in Table 3, the exposure routes considered applicable for soil exposure include incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dusts. Since benzene was not detected in soils, soil vapors will not be modeled. Given the industrial nature of the PPPI site, PPPI employees and construction workers are the populations for which exposure is evaluated. The likelihood for significant surface soil exposure for PPPI employees is low, because the area of the former drum burial area is so

small (e.g., 500 square feet), and is covered by grass which is mowed on a regular basis. Subsurface soil exposure would unlikely occur unless construction workers were contracted to perform intrusive work in the area of the former drum burial area. However, each of these exposure pathways is assessed in the Focused BIRA.

The potential for groundwater exposure was considered in the CSM. Currently, the PPPI facility and the surrounding area are supplied with municipal water, which is supplied from off-site sources. For this reason, it is highly unlikely that exposure to the shallow contaminated groundwater would ever occur. For information purposes, the risk associated with consumption of the shallow groundwater by a hypothetical future employee was evaluated assuming a well was placed in the shallow aquifer. Under this scenario the ingestion route of exposure was evaluated. The other potential groundwater exposure scenario is addressed qualitatively in this Focused BIRA for direct contact, incidental ingestion, and vapor inhalation associated with construction worker exposure to groundwater in an excavation. The water table varies across the site, and there is the possibility depending upon the time of the year and depth of the excavation that groundwater may seep into a construction excavation. However, because construction workers would conduct excavation only a short period of time and would use protection such as rubber boots to protect from getting wet, this exposure pathway is handled qualitatively.

To estimate the potential magnitude of chemical exposure from each exposure pathway, exposure point concentrations (EPCs) are developed to represent the chemical concentration a receptor might be exposed. For purposes of this Focused BIRA the following procedures were used to develop EPCs for each analyte.

Soil

The construction worker scenario was performed using the maximum analyte concentrations from all depths above 10 feet below ground surface.

The industrial worker (PPPI employee) scenario was performed using the maximum concentrations from the surface soil samples (top 2 feet of soil) for direct contact with soils.

Groundwater

The maximum average concentration of an analyte was used to estimate the EPC for industrial workers under the hypothetical scenario a well is constructed in the shallow aquifer and workers consume the water.

The maximum average concentration for a given analyte was calculated using the arithmetic average of the available monitoring data for a given well from the period of 1999 to present (refer to Table 2).

To estimate the magnitude of chemical exposure to each receptor (employee or construction worker) the EPCs were used in conjunction with standard exposure dose equations presented in Table 4 and the exposure factors presented in Table 5. The actual calculated exposure doses are presented on the risk characterization tables presented latter within this report. The exposure factors selected (e.g., body weight and exposure frequency) are documented in Table 5. If a particular exposure factor is based in part on professional judgment, the rationale is provided. These exposure factors were approved as part of the Focused BIRA Work Plan.

TOXICITY ASSESSMENT

The toxicity assessment evaluates the toxicity characteristics of each chemical of potential concern. The four COPCs evaluated in the Focused BIRA have a range of toxicological effects depending upon the magnitude and duration of exposure. A toxicity profile for each of the COPCs is provided in Attachment B. Chemicals can elicit either noncancer type health effects and/or cancer type effects depending upon their nature. Benzene and arsenic are known human carcinogens and also can cause a range of noncancer type effects. Lead and barium are not known to be human carcinogens, but produce a variety of toxic effects depending upon the magnitude and duration of exposure.

Table 6 presents the toxicity values and absorption estimates used in the Focused BIRA to assess the magnitude of toxicity of each COPC. Toxicity values were obtained from the USEPA's Integrated Risk Information System (IRIS) [searched October 2002] and USEPA's "Health Assessment Summary Tables" (HEAST) FY1997. When a value was not available, provisional values were used as referenced in the Region 3 Risk-Based Concentration Table [downloaded October 2002]. Both subchronic and chronic reference doses are presented for the noncarcinogenic effects of a chemical. Subchronic reference doses are used to represent the toxic potency of a chemical if the duration of exposure is less than seven years (i.e., construction worker scenario). Chronic reference doses are used to represent the toxic potency of a chemical when the exposure duration is greater than seven years (i.e., employee scenario).

Note that no toxicity values are provided for lead. Lead concentrations were compared to appropriate toxicity benchmarks such as USEPA Region IX industrial preliminary remediation goals (PRGs) for soil (750 mg/kg) [USEPA Comment No.1] and USEPA

maximum contaminant levels (MCLs) for groundwater. This comparison is performed as part of the risk characterization section.

It should be noted that the 750 mg/kg PRG for lead in soil was developed incorporating multiple routes of exposure to lead using a specific modeling approach adopted by USEPA. The 750 mg/kg value was developed to protect the developing fetus of a pregnant female worker by considering the lead exposure the fetus may receive through the mother from multiple exposure pathways. This is considered the most conservative adult scenario available to address potential lead exposure and risk. The model addresses the potential for a mother to be exposed to lead through inhalation of air, and ingest of food and water, and the incidental ingestion of soil/dust with a particular factor that is built into the model. This is explained within the *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* [EPA-540-R-03-001, OSWER Dir #9285.7-54] (January 2003). [USEPA Comment No. 1]

Reference doses and slope factors designated for the dermal route of exposure are not available from IRIS or HEAST, but rather are calculated from the corresponding toxicity values for the oral route of exposure. The oral toxicity values, which are based on an administered dose, are used in conjunction with oral absorption estimates to estimate absorbed dose toxicity values based on an absorbed (in contrast to an administered) level of chemical. All dose estimates for the dermal route of exposure are based on an absorbed dose. The following relationships were used to derive dermal toxicity values:

$$\text{Oral Reference Dose (administered)} \times \text{Oral Absorption Estimate} = \text{Dermal Reference Dose (absorbed)}$$
$$\text{Oral Slope Factor (administered)} / \text{Oral Absorption Estimate} = \text{Dermal Slope Factor (absorbed)}$$

This above approach was used only when the absorption of the chemical was estimated to be less than 50 percent. If the absorption of the chemical was greater than 50 percent, then the oral toxicity value was set equal to the dermal toxicity value.

The amount of chemical absorbed through the skin into the body from soil is needed to estimate the dose resulting from dermal exposure to soil. This parameter is termed the fraction of dermal absorption, and is chemical-specific. Values have been established by USEPA in the Draft RAGS Part E Dermal Risk Assessment Interim Guidance (2001) document.

RISK CHARACTERIZATION AND UNCERTAINTY ANALYSIS

Risks were quantified based on the exposure estimates and the toxicity of each analyte. For carcinogens, risk estimates represent the incremental probability an individual will develop cancer over a lifetime as a result of exposure to a potential carcinogen or a set of carcinogens (EPA, 1989). These risks are termed excess or incremental individual lifetime cancer risks and are calculated using the following equation:

$$\text{Cancer Risk (Risk)} = \text{LDI} \times \text{CSF}$$

where: LDI = Lifetime Daily Intake (mg/kg/day)
 CSF = Cancer Slope Factor (mg/kg/day)

A carcinogenic risk is expressed as a probability, such as one additional cancer in an exposed population of one million, which is expressed in scientific notation as 1×10^{-6} .

Studies of carcinogenicity tend to focus on identifying the slope of the linear portion of a curve of dose versus response (i.e., that response being cancer). A plausible upper-bound value of the slope is called the CSF. In accordance with current scientific policy concerning carcinogens, it is assumed that any dose, no matter how small, has some associated response. This is called a nonthreshold effect. The lifetime daily intake is the exposure dose averaged over a 70-year lifetime. In keeping with the concept, there are no threshold doses for carcinogens.

For a given pathway, an individual may be exposed to more than one chemical. To estimate the total carcinogenic risk potential for each exposure pathway, risks are summed for each chemical within the pathway. The cumulative cancer risk was then determined by summing the pathway risks. The USEPA generally considers a cumulative cancer risk exceeding 1 in 10,000 (1×10^{-4}) to be unacceptable and may require remediation. Cancer risks less than one in 1,000,000 (1×10^{-6}) are considered *de minimis* risks. It requires close scrutiny when a cumulative cancer risk ranges between 1×10^{-6} and 1×10^{-4} . Cancer risks as high as 1×10^{-4} may be considered potentially acceptable under the National Contingency Plan. The USEPA has issued a directive stating action is generally not warranted when carcinogenic risks are less than 1×10^{-4} , although a risk manager may decide lower risks are unacceptable for site-specific reasons (EPA, 1991c). This directive further states that the upper boundary of the risk range is not a discrete line at 1×10^{-4} , although this value is generally used in risk management decisions. Note this discussion applies to the requirements for remediation with respect to the cancer risk only; there can be other reasons for remediation even though the cancer risk is considered acceptable.

The potential for individuals to experience adverse effects other than cancer is evaluated by comparing an exposure dose developed over a specific exposure period to a reference dose (RfD) developed over a similar exposure period. This comparison takes the form of a ratio termed the hazard quotient, which is calculated by dividing the chronic daily intake (CDI) by the RfD:

$$\text{Hazard Quotient} = \frac{\text{CDI}}{\text{RfD}}$$

where: CDI = Chronic Daily Intake (mg/kg/day)
 RfD = Reference Dose (mg/kg/day)

The RfD represent a chronic or subchronic exposure period, depending on the scenario. A chronic RfD is an estimate of a daily exposure level for which people, including sensitive individuals, do not have an appreciable risk of suffering significant adverse health effects. If the hazard quotient is less than 1, no adverse health effects are expected. If the hazard quotient is greater than 1, then adverse health risks may exist. Chronic RfDs were used for exposures longer than 7 years. Subchronic RfDs were used for shorter exposure durations, such as experienced by a construction worker.

The following is a summary of the health risks by media (soil or groundwater) and potentially exposed population (employees and construction workers) along with any key uncertainties associated with the health risks. It should be noted that risks were not combined across exposure pathways (soil and groundwater) for the two populations evaluated, because of the hypothetical nature of the groundwater exposure for employees, and that the qualitative nature of the groundwater risk evaluation for construction workers. In the future, if the on-site groundwater were to be utilized by on site employees, the risks would be additive to the soil risks estimated for the employees. [USEPA Comment No. 1] The pathway specific risk estimates are provided in Tables 7, 8, and 9.

Soil Health Risk Estimates

Risks associated with residual soil at the former drum burial area were assessed for both PPPI employees and construction worker populations. It should be noted that these risk estimates are very conservative in nature since they are developed assuming a population would have exposure to the maximum concentration of cumulative cancer risk to each analyte over the entire period of exposure.

Employee. The exposure and risk estimates for employee exposure to the former drum disposal area are summarized in Table 7. It was assumed that a worker would be exposed to soil through incidental ingestion of surface soil, dermal contact with surface soil, and inhalation of fugitive dusts derived from wind erosion of surface soils. The duration of soil exposure was assumed to continue for 25 years for an average of 190 days per year. Based on these exposure conditions, noncancer type health risks would not be anticipated because the Hazard Index (HI) was estimated to be 0.01, which is much less than 1. In addition the cumulative cancer risk due to arsenic exposure was 2×10^{-6} , which is well below the upper end of the cancer risk range (i.e., 1×10^{-4}).

Risks to lead cannot be assessed in the same way as other noncarcinogenic chemicals, because no reference does are available for lead. To assess risks to lead, a comparison to the USEPA Region 9 industrial soil PRG (i.e., 750 mg/kg) was made to the maximum concentration of lead detected in surface soil. The lead PRG is based on modeling conducted by the USEPA using a model developed specifically to assess risks associated with environmental lead exposure, and concentrations below the lead PRG should not pose a health concern. The maximum concentration of lead in surface soil was 167 mg/kg, which is well below the soil PRG, and so exposure to lead should not pose a health concern to employees.

Considering these above results, the residual concentrations of arsenic, barium, and lead in the former drum burial area should not pose a health concern to employees. Benzene was not detected in soil is this area.

In addition, because of the small area of the former buried drum disposal area (i.e., approximately 500 square feet), the amount of exposure an employee would have to soil in this area would be limited. To develop the risk estimates, it was assumed all of an employee's soil exposure would occur in this small area (meaning the fraction ingested [FI] value is set to 1 or 100 percent). The FI value represents the proportion of daily soil intake that is derived from the area of concern. Because of the size of the site in relation to the size of the former drum burial area, an FI value of 0.1 or less could be justified, which would reduce the risk estimates presented previously by a full order of magnitude.

Construction Workers. The exposure and risk estimates for construction worker exposure to the former drum burial area is summarized in Table 8. It was assumed that a construction worker would be exposed to soil (either surface or subsurface) through incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dusts derived from disturbing soils during construction activities. The duration of soil exposure was assumed to continue for 1 year for an average of 190 days per year. During 90 days

(or three months) it was assumed that intrusive activities might occur on-site, such as digging, backfilling, or regrading. For the remainder of the time, workers were considered to do activities that would result in less soil exposure (e.g., electrical wiring, painting, etc.). Based on these exposure conditions, noncancer type health risks would not be anticipated because the HI was estimated to be 0.05, which is much less than 1. In addition the cumulative cancer risk due to arsenic exposure was 4×10^{-7} , which is less than the lower end of the risk range.

Risks to lead were assessed using the same approach that was used for employees. The maximum concentration of lead in any soil sample collected from the area was 715 mg/kg, which is below the industrial soil PRG, and so exposure to lead should not pose a health concern to construction workers.

Considering these above results, the residual concentrations of arsenic, barium, and lead in the former drum burial area should not pose a health concern to employees. Benzene was not detected in soil in this area.

It should be noted the uncertainty discussed previously for the employee scenarios applies also to the construction worker population. This is due to the consideration a construction project would most likely occur over a much larger area than the former drum burial area. In addition, based on the vertical profile of soil analytical results, the maximum concentration of each analyte used to assess risk likely overestimates the average concentration of an analyte that a construction worker would be exposed to.

Groundwater Health Risks Estimates

Risks associated with shallow groundwater contamination in the northeast area of the site were assessed for both a future hypothetical employee scenario and construction worker scenario. It should be noted that these risk estimates are very conservative in nature since they are developed assuming that a population would have exposure to the maximum average concentration of each analyte in the shallow groundwater. The shallow groundwater is not used for supplying drinking water currently and would not be expected to in the future. The risks to a hypothetical population of employees drinking shallow groundwater was quantitatively assessed, [USEPA Comment No. 2] while the risk associated with incidental exposure to groundwater during construction activities is addressed qualitatively. It should be noted that the hypothetical risks associated with employees consuming groundwater would add directly to the risks predicted for soil employees under current conditions. However, because the groundwater exposure pathway is not complete,

it did not appear appropriate to add the quantitative groundwater and soil risk estimates together at this time. [USEPA Comment No.1]

Hypothetical Employee. Under current conditions, the PPPI facility and the surrounding area is supplied by a municipal water distribution system, and so exposure to the shallow contaminated groundwater at the site does not occur. For this reason, the shallow groundwater does not pose a current health threat to employees.

However, for informational purposes, a hypothetical scenario was created to assess the risk to shallow groundwater if a well were constructed on site. The exposure and risk estimates for this hypothetical scenario are summarized in Table 9. It was assumed that a hypothetical employee would be exposed to shallow groundwater through ingestion of the water from a on-site drinking water well. The duration of groundwater exposure was assumed to continue for 25 years for an average of 250 days per year. Based on these exposure conditions, noncancer type health risks would be anticipated because the HI was estimated to be 11, which is much greater than 1. In addition, the cumulative cancer risk due to groundwater exposure was 2×10^{-3} , which is well above the upper end of the cancer risk range (i.e., 1×10^{-4}). The primary chemical of concern is arsenic for both types of effects (i.e., cancer and noncancer).

Risks to lead can not be assessed in the same way as other noncarcinogenic chemicals, because no RfD is available for lead. To assess risks to lead, a comparison to the MCL for lead (i.e., 15 $\mu\text{g/L}$) was made to the maximum average concentration of lead detected in shallow groundwater. The MCL for lead represents an action limit for tap water that is to be applied at the tap. This is referenced in the USEPA Office of Water document entitled *2002 Edition of the Drinking Water Standards and Health Advisories*. [<http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf>] [USEPA Comment No. 3] The maximum average concentration of lead in shallow groundwater was 12 $\mu\text{g/L}$, which is below the MCL, and so exposure to lead would not be anticipated to pose a health concern to employees.

Considering these above results, the residual concentrations of arsenic in shallow groundwater would pose a concern under the hypothetical scenario if a drinking water well was constructed in the shallow aquifer in the northeast portion of the site.

It should be noted that there are two main uncertainties associated with this hypothetical scenario. These include the likelihood this exposure pathway would be complete in the future, and the representativeness of the concentrations of inorganic constituents detected in the groundwater. It is very unlikely this exposure pathway would ever be complete,

because the groundwater contamination is localized on-site in a shallow zone that would unlikely be able to be used as a drinking water source. In addition, the site is in the City of Des Moines, Iowa where the municipality supplies drinking water. In regard to the representative of the exposure point concentration used to assess the hypothetical risks of drinking the shallow groundwater, the concentrations were biased high because the maximum average concentrations were used. In review of the northeast groundwater data, the maximum concentrations of each analyte are localized in specific wells within the shallow zone of the aquifer. Constituents of concern were not typically detected in the deeper "B" series of wells. Also, the elevated concentrations of arsenic, barium, and lead in the shallow groundwater appear to be in part related to the high turbidity in the water samples. Water with high turbidity would not be used as a drinking water source. Considering these factors, it is unlikely that the shallow groundwater would be used for drinking purposes.

Construction Worker. The risk associated with incidental exposure to groundwater during construction activities is addressed qualitatively herein. In the event that a construction project would include excavating soils, there is the possibility that groundwater may seep into the excavation because the water table varies from about 6 to 10 feet below ground surface. The longer a person is in dermal contact with groundwater or the more that a worker ingests groundwater within the trench the greater exposure they would potentially have to benzene. In addition, the longer they are in the trench, they would have the potential to inhale air containing benzene. Another important factor in determining the magnitude of potential chemical exposure is the concentration of the constituents in groundwater. Exposure to the groundwater seepage could occur via incidental ingestion of groundwater, dermal contact with the groundwater, and inhalation of vapors for those chemicals such as benzene that are volatile. The amount of exposure through these pathways is considered to be insignificant since the time that a worker would spend in a wet excavation would be anticipated to occur for only a matter of hours, while performing work in the excavation. In addition, workers may wear protective clothing to prevent exposure to the water in the excavation preventing dermal contact with the water. Also, based on Occupational Safety and Health Administration (OSHA) regulations, workers are not to be allowed to work in excavations with standing water. Therefore, if standing water occurs in an excavation, it must be removed or other construction methods utilized to avoid worker contact with the water. Keeping groundwater out of the excavation would minimize the potential for contact and incidental ingestion of the groundwater, and minimize groundwater exposure. Also, the average concentration of benzene (the only volatile COC) in the most contaminated well is quite low (i.e., 34 µg/l) and the next highest average benzene concentration in a monitoring well is 1 µg/L. Therefore, the benzene concentration of groundwater seeping into a trench would be

expected to be low. At such low benzene groundwater concentrations, benzene vapors would not be expected in the trench, as fresh air would dilute any benzene that would be volatilized from the groundwater. In addition, even if a worker contacted the water, they would receive insignificant levels of exposure due to the low concentration of benzene and the short duration of exposure. Because of the limited duration of exposure, and limited contact that would occur with any water in the excavation, this would minimize the magnitude of any potential exposure. [USEPA Comment No.4] Considering these conditions, construction worker exposure to groundwater is not anticipated to pose a health concern.

REFERENCES

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CLOSING

I would appreciate your comments on this Focused BIRA. If you have questions, please feel free to contact Jeff Coon or Shari Klika.

Sincerely,

MWH AMERICAS, INC.



Michael W. Kierski, Ph.D.
Supervising Environmental Scientist

Enclosures: Table 1 - Summary of Soil Data for the Former Burial Drum Storage Area
Table 2 - Summary of Northeast Monitoring Well Results (1999 to Present)
Table 3 - Conceptual Site Model / Matrix of Potentially Complete Exposure Pathways
Table 4 - Equations Used for Quantitation of Exposure Estimates
Table 5 - Exposure Factors used for the Calculation of Exposure Estimates
Table 6 - Chemical Toxicity Values and Absorption Estimates Used for Risk Quantification
Table 7 - Exposure Dose and Risk Estimates, Employee Exposure to Former Drum Burial Area Surface Soil
Table 8 - Exposure Dose and Risk Estimates, Construction Worker Exposure to Former Drum Burial Area Soils
Table 9 - Exposure Dose and Risk Estimates, Hypothetical Worker Exposure to Shallow Groundwater
Figure 1 - Monitoring Well Location Map
Attachment A - Correspondence since Work Plan Submittal
Attachment B - Toxicity Profiles for COCs

cc: Shari Klika, PPPI
Dave Fisher, PPPI
Jeffrey Coon, MWH

/mwk:jlc:hls:vas

TABLE 1

SOIL ANALYTICAL DATA OF CHEMICALS OF CONCERN - FORMER BURIED DRUM AREA (mg/kg)
PECHINEY PLASTICS PACKAGING INC., DES MOINES, IOWA

Sampling Location	Sampling Date	Sampling Depth (ft. bgs)	Benzene Qualifier	Benzene Concentration	Arsenic Qualifier	Arsenic Concentration	Barium Qualifier	Barium Concentration	Lead Qualifier	Lead Concentration
SB-3	10/18/1993	0-1	<	0.005		5.4	88.9			167
		2-3	<	0.005		2.1	92.3			715
		3.2-3.4	<	0.005		NA	NA			NA
		5-6.5	<	0.005		0.6	41.3			6.5
SB-4	10/19/1993	0-1	<	0.005		3.1	72.2			34.3
		2-3	<	0.005		3.1 ^a	70.4			189 ^a
		3-4	<	0.30		NA	NA			NA
		5-6.5	<	0.005		0.6	53.2			11.6
SB-5	10/19/1993	0-1	<	0.005		3.3	76.6			17.3
		2-3	<	0.005		1.9	73.8			34.7
		4-4.5	<	0.005	<	0.6	56.5		<	5.0
		5-6.5	<	0.005	<	0.6	57.5		<	5.0

Notes:

- 1) mg/kg
- 2) ^a milligrams per kilogram
- 3) concentration of duplicate sample
- 4) less than (concentration is below method detection limit)
- 5) Not analyzed
- 6) ft. bgs
- 7) feet below ground surface

TABLE 2

HISTORICAL GROUNDWATER MONITORING DATA OF CHEMICALS OF CONCERN - NORTHEAST WELLS (µg/L)
PECHINEY PLASTICS PACKAGING INC., DES MOINES, IOWA

Well	Sampling Date	Benzene Qualifier	Benzene Concentration	Arsenic ^a Qualifier	Arsenic ^a Concentration	Barium ^a Qualifier	Barium ^a Concentration	Lead ^a Qualifier	Lead ^a Concentration
MW-2	8/19/1999	<	1	<	5		184		9
	8/8/2001	<	1	<	5		NA		10
	11/14/2001	<	1	<	5		NA	<	5
	8/15/2002	<	1	<	5		238		18
	11/5/2002	<	1	<	5		209	<	5
	AVERAGE						210		9
MW-2B	8/27/1999	<	1		879		11,200		1,090
MW-2C	11/14/2001	<	1	<	5		NA	<	5
	8/15/2002	<	1	<	5		354	<	5
	11/5/2002	<	1	<	5		433	<	5
MW-3A	8/23/1999		41.2		358		429	<	5
	8/15/2002		16		320		483	<	5
	11/5/2002		44		306		453	<	5
	AVERAGE		34		328		455		
MW-4A	8/23/1999	<	1		23		250	<	5
	8/15/2002	<	1		25		376		6
	11/5/2002	<	1		20		212	<	5
	AVERAGE				23		279		
MW-5	8/23/1999	<	1		8		754		20
	8/9/2001	<	1		19.3		NA	<	5
	11/13/2001	<	1		10		NA	<	5
	8/16/2002	<	1		8.1		486	<	5
	11/6/2002	<	1		7		475	<	5
	AVERAGE				10		572		8
MW-6A	8/19/1999		14.6		84		594		158
MW-6B	8/20/1999	<	1	<	5		720	<	5
MW-7A	8/23/1999	<	1	<	5		156	<	5
	8/9/2001	<	1	<	5		NA	<	5
	11/13/2001	<	1	<	5		NA	<	5
MW-8A	8/23/1999	<	1	<	5		289	<	5
	8/8/2001	<	1	<	5		NA		27
	11/13/2001	<	1	<	5		NA	<	5
	AVERAGE								12
MW-9A	8/23/1999	<	1		43		421	<	5
	8/14/2002	<	1		98		461	<	5
	11/5/2002	<	1		57		361	<	5
	AVERAGE				66		414		5
MW-10A	8/23/1999	<	1		18		851		5
	8/7/2001	<	1	<	5		NA		7
	11/12/2001	<	1		7		NA	<	5
	8/15/2002	<	1	<	5		551	<	5
	11/4/2002	<	1		15		591	<	5

TABLE 2

**HISTORICAL GROUNDWATER MONITORING DATA OF CHEMICALS OF CONCERN - NORTHEAST WELLS (µg/L)
PECHINEY PLASTICS PACKAGING INC., DES MOINES, IOWA**

Well	Sampling Date	Benzene Qualifier	Concentration	Arsenic ^a Qualifier	Concentration	Barium ^a Qualifier	Concentration	Lead ^a Qualifier	Concentration
	AVERAGE				10		664		
MW-10B	8/23/1999	<	1	<	5		980	<	5
	8/7/2001	<	1	<	5		NA	<	5
	11/12/2001	<	1		6		NA	<	5
	8/15/2002	<	1	<	5		420	<	5
	11/4/2002	<	1	<	5		459	<	5
	AVERAGE						620		
MW-11A	8/19/1999	<	1		391		811	<	5
	8/15/2002		1		205		586	<	5
	11/4/2002		2		341		520	<	5
	AVERAGE		1		312		639		
MW-12A	8/20/1999	<	1	<	5		155	<	5
	8/7/2001	<	1	<	5		NA	<	5
	11/14/2001	<	1	<	5		NA	<	5
	8/14/2002	<	1	<	5		93	<	5
	11/4/2002	<	1	<	5		94	<	5
	AVERAGE						114		
MW-12B	8/20/1999	<	1	<	5		457	<	5
	8/7/2001	<	1	<	5		NA	<	5
	11/14/2001	<	1	<	5		NA	<	5
	8/14/2002	<	1	<	5		322	<	5
	11/4/2002	<	1	<	5		393	<	5
	AVERAGE						391		
MW-13B	8/23/1999	<	1	<	5		1,430	<	5
	8/7/2001	<	1	<	5		NA	<	5
	11/14/2001	<	1	<	5		NA	<	5
	8/15/2002	<	1	<	5		177	<	5
	11/4/2002	<	1	<	5		241		6
	AVERAGE						616		
MW-20A	8/19/1999	<	1		8		508		7
	8/15/2002	<	1	<	5		237	<	5
	11/4/2002	<	1	<	5		201	<	5
	AVERAGE						315		

Notes:

- 1) µg/L micrograms per liter
- 2) ^a total (unfiltered) metals concentration
- 3) < less than (concentration is below method detection limit)
- 4) NA Not analyzed
- 5) Wells labeled with an "A" and those without letter designations are shallow wells screened at 10'-20' below ground surface.
- 6) Wells labeled with a "B" or "C" are deeper wells screened at 40'-50' below ground surface.

TABLE 3

**CONCEPTUAL SITE MODEL / MATRIX OF POTENTIALLY COMPLETE EXPOSURE PATHWAYS
FOCUSED BASELINE RISK ASSESSMENT
PECHINEY PLASTIC PACKAGING, INC. SITE - DES MOINES, IOWA**

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Exposure Route(s)	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Groundwater	Tap Water	PPPI Employees	Ingestion	On-Site	Hypothetical Quantitative	The facility obtains drinking water from a municipal source that could not be affected by PPPI site contamination. In addition, the site contamination is localized. However, a quantitative analysis of potential risks assuming employee ingestion groundwater will be performed for informational purposes under the hypothetical scenario that a drinking water well is placed in the contaminated aquifer.
				Construction Workers	Ingestion	On-Site	None	Construction workers would be on-site for a short period of time. Their opportunity to drink water supplied by PPPI would be quite limited.
				PPPI Employees	Inhalation	On-Site	None	Employees' exposure to benzene vapors will not be quantified. Based on the first round of 2002 groundwater monitoring, only two wells (MW-3A and MW-11A) contain detectable concentrations of benzene. Based on the locations of these wells (see Figure 1), it does not appear that benzene vapors from groundwater would enter the site building.
				PPPI Employees	Ingestion Dermal	On-Site	Quantitative	Employees could have exposure to surficial soils (top 2 feet of soil) that are accessible (i.e., in their work area where soil is not covered by pavement, buildings, or dense vegetation).
Current	Soil	Soil	Soils in Former Buried Drum Area	Construction Workers	Ingestion Dermal	On-Site	Quantitative	Construction workers could have dermal contact and incidental ingestion with soil constituents to a depth of 10 feet below ground surface.
				PPPI Employees	Inhalation	On-Site	Quantitative	Inhalation of contaminated dust evaluated for all worker scenarios. Employees may inhale dust associated with wind erosion from the former buried drum area as well as volatilization of vapors from the soil.
				Construction Workers	Inhalation	On-Site	Quantitative	Construction workers could inhale dust and vapors containing site constituents during construction activities to a depth of ten feet below ground surface.
				PPPI Employees	Inhalation	On-Site	Quantitative	

Note: This conceptual site model presents those potential exposure pathways applicable for Pechiney Plastic Packaging, Inc. (PPPI) employees and construction workers. Other receptors (e.g., residents) were not evaluated because the property is zoned as industrial and will continue as such into the future.

TABLE 4

**Equations Used for Quantitation of Exposure Estimates
Pechiney Plastic Packaging, Inc.
Des Moines, Iowa**

Dermal Contact with Contaminants in Soil

$$\text{Absorbed Dose (mg/kg-day)} = \frac{\text{CS} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{FC} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

CS = Chemical concentrations in soil (mg/kg)

CF = Conversion factor (10^{-6} kg/mg)

SA = Skin surface area available for contact (cm^2/event)

AF = Soil to skin adherence factor (mg/cm^2)

ABS = Absorption factor (unitless)

FC = Fraction of soil from contaminated areas

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged-days)

Incidental Ingestion of Contaminants in Soil

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{CF} \times \text{FI} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

CS = Chemical concentrations in soil (mg/kg)

IR = Ingestion rate (mg/day)

CF = Conversion factor (10^{-6} kg/mg)

FI = Fraction ingested from contaminated source (unitless)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged-days)

Inhalation of Fugitive Soil Emissions

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times (1/\text{PEF}) \times \text{FC} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

CS = Chemical concentration in soil (mg/kg)

IR = Inhalation rate (m^3/day)

PEF = Particulate emission factor (m^3/kg)

FC = Fraction from contaminated source (unitless)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged - days)

TABLE 4 (continued)

**Equations Used for Quantitation of Exposure Estimates
Pechiney Plastic Packaging, Inc.
Des Moines, Iowa**

Incidental Ingestion of Chemicals in Groundwater

$$\text{Intake (mg/kg-day)} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

CW = Contaminant concentration in water (mg/L)

IR = Water ingestion rate (L/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged-days)

General Note:

The equations presented were used to calculate chemical intakes or absorbed doses for the pathway and route of exposure indicated. Refer to Table 5 for the exposure factors (e.g., EF, BW, etc.) used in conjunction with these equations to quantitate exposure estimates.

MWK/vlr/JCF

N:\Jobs\208\2521\Draft BIRA (QC Complete)\Table 4.doc

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TABLE 5
EXPOSURE FACTORS USED FOR THE CALCULATION OF EXPOSURE ESTIMATES
FOCUSED BASELINE RISK ASSESSMENT
PECHINEY PLASTIC PACKAGING, INC. SITE - DES MOINES, IOWA

	Construction Worker	Industrial Worker
<u>Receptor Characteristics</u>		
Body Weight (kg)	70 ^(a)	70 ^(a)
Exposure Duration (years)	1.0 ^(b)	25 ^(a)
Averaging Time (days)		
Noncancer Effects	365	9,125
Cancer Effects	25,550	25,550
<u>Chemical Characteristics</u>		
Dermal Absorption Estimates (unitless)	Chemical Specific See Table 3	Chemical Specific See Table 3
Oral Absorption Estimates (unitless)	Chemical Specific See Table 3	Chemical Specific See Table 3
Volatilization Factor (VF) (m ³ /kg)	592 See Attachment A	2,960 See Attachment A
Particulate Emission Factor (PEF) (m ³ /kg)	1.0E+06 ^(c1)	1.30E+09 ^(c2)
<u>Soil</u>		
Skin Surface Area Available for Contact (cm ²)	3,300 ^(d)	3,300 ^(d)
Soil Ingestion Rate (mg/day)	480/50 ^(e)	50 ^(a)
Soil to Skin Adherence Factor (mg/cm ²)	0.2 ^(f)	0.2 ^(g)
Fraction Ingested/Contacted From Contaminated Source (unitless)	1.0 ^(h)	1.0 ^(h)
Inhalation Rate (M3/day)	20 ^(a)	20 ^(a)
Exposure Frequency (days/year)	190 ⁽ⁱ⁾	190 ⁽ⁱ⁾
<u>Groundwater</u>		
Ingestion Rate (l/day)	---	1 ^(j)
Exposure Frequency (days/year)	---	250 ^(a)

Footnotes:

- ^(a) RAGS supplemental guidance (U.S. EPA, 1991).
- ^(b) Professional judgement. Construction workers are assumed to engage in a one-year long construction project. This corresponds to a large construction project.

TABLE 5 (continued)

EXPOSURE FACTORS USED FOR THE CALCULATION OF EXPOSURE ESTIMATES
FOCUSED BASELINE RISK ASSESSMENT
PECHINEY PLASTIC PACKAGING, INC. SITE - DES MOINES, IOWA

Footnotes (Continued):

- (c1) Professional judgement. To estimate the concentration of dust that is inhaled by construction workers during construction activities, a conservatively high dust concentration of 1 milligram per cubic meter (mg/m^3) was assumed. This equates to a PEF of $1.0\text{E}+06$ using the equation:

$$\text{Dust Concentration (mg/m}^3\text{)} = 1/(\text{PEF (cubic meter per kilogram [m}^3\text{/kg)]} \times 1.0\text{-E06 (kilogram per milligram [kg/mg]))}.$$

- (c2) Default value from Soil Screening Guidance (U.S. EPA, 1996).
- (d) Reasonable maximum exposure scenario skin surface areas for soil contact by construction and industrial workers obtained from RAGS Part E, Supplemental Guidance for Dermal Risk Assessment (U.S. EPA, 2001).
- (e) Professional judgment. Construction workers are assumed to engage in contact-intensive work for 90 days during a project, during which the higher soil ingestion rate applies. The remainder of the project (100 days; see footnote ⁽ⁱ⁾) is assumed to consist of activities such as roofing or electrical wiring with less contact with soil, and the lower soil ingestion rate.
- (f) Highest geometric mean adherence factor for construction workers, heavy equipment operators, and utility workers (U.S. EPA, 2001), who all engage in activities typical of construction workers.
- (g) Recommended value for a commercial/industrial adult worker (U.S. EPA, 2001).
- (h) The fraction ingested/contacted/inhaled value was conservatively assumed to be 1 for all receptors; that is the receptor consumes or contacts 100 percent of soil or sediment within chemically impacted areas on site.
- (i) Workers are assumed to be present on site for 250 days per year. However, regional climatic data from Dubuque, Iowa and Moline, Illinois indicates that almost 60 days per year will have at least 1 inch of snow on the ground that will eliminate dust, and the potential for dermal contact and incidental soil ingestion. For 50 percent of the years recorded, these cities yielded an average of 58 days with 1 or more inches of snow cover (State of Iowa's Climatologist Office, April 19, 2000).
- (j) Assumed to be one-half of the total water consumed under a reasonable maximum exposure scenario for a resident of 2 liters/day (U.S. EPA, 1991).

cm^2 = Square centimeter.

mg/cm^2 = Milligram per square centimeter.

TABLE 6

**CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES USED FOR RISK QUANTIFICATION
FOCUSED BASELINE RISK ASSESSMENT
PECHINEY PLASTIC PACKAGING, INC. SITE - DES MOINES, IOWA**

Chemical	Reference Dose (mg/kg-day)								Slope Factor (kg-day/mg)			Oral Absorption Estimate (unitless)	Dermal Absorption Estimate (unitless)
	Inhalation		Oral				Dermal						
	Subchronic	Chronic	Subchronic	Chronic	Subchronic	Chronic	Inhalation	Oral	Dermal				
VOLATILES													
	NI	1.7E-03 E	NI	3.0E-03 E	NI	3.0E-03	2.7E-02 I	5.5E-02 I	5.5E-02	0			
METALS													
Arsenic	NI	NI	3.0E-04 I	3.0E-04 I	3.0E-04	3.0E-04	1.5E+01 I	1.5E+00 I	0.95	0.03			
Barium	1.4E-03 A	1.4E-04 A	7.0E-02 H	7.0E-02 I	4.9E-03	4.9E-03	NC	NC	0.07	NA			
Lead	NR	NR	NR	NR	NR	NR	NR	NR	0.15	NA			

Notes:

Toxicity values were obtained from the U.S. EPA's Integrated Risk Information System (IRIS) (searched October 2002) and U.S. EPA's "Health Assessment Summary Tables" (HEAST) FY1997. When a value was not available, provisional values were used as referenced in the Region 3 Risk-Based Concentration Table (downloaded October 2002). Both subchronic and chronic reference doses are presented for the noncarcinogenic effects of a chemical. Subchronic reference doses are used to represent the toxic potency of a chemical if the duration of exposure is less than seven years. Chronic reference doses are used to represent the toxic potency of a chemical when the exposure duration is greater than seven years.

Reference doses and slope factors designated for the dermal route of exposure are not available from IRIS or HEAST, but rather are calculated from the corresponding toxicity values for the oral route of exposure. The oral toxicity values which are based on an administered dose are used in conjunction with oral absorption estimates, to estimate absorbed dose toxicity values based on an absorbed (in contrast to an administered) level of chemical. All chemical dose estimates for the dermal route of exposure are based on absorbed chemical levels. The following relationships were used to derive dermal toxicity levels:

Oral Reference Dose (administered) x Oral Absorption Estimate = Dermal Reference Dose (absorbed)

Oral Slope Factor (administered) / Oral Adsorption Estimate = Dermal Slope Factor (absorbed)

This above approach was used only when the absorption of the chemical was estimated to be less than 50 percent. If the absorption of the chemical is greater than 50 %, then the oral slope factor equals the dermal slope factor. All oral absorption estimates were assumed to be based on administered doses based on a review of available data in IRIS.

The dermal absorption estimates were determined based on guidelines in Draft RAGS Part E (USEPA 2001).

Footnotes:

I = IRIS.

H = HEAST.

E = Provisional values from National Center for Exposure Assessment (NCEA) as referenced in the USEPA Region 3 Risk-Based Concentration Table.

ND = No value found in IRIS or HEAST.

VF = Volatilization Factor.

A = Value under review, by IRIS (value presented is from HEAST).

NR = Not relevant because lead concentrations will be compared to toxicity benchmarks in order to estimate risks due to lead exposure (see text for more details).

NI = No information available.

NC = Noncarcinogen thus no slope factor available.

NA = Not available.

mg = Milligram.

kg = Kilogram.

Table 7

EXPOSURE AND HEALTH RISK ESTIMATES
Reasonable Maximum Exposure

Pechiney Plastic Packaging, Inc. Site
Des Moines, Iowa

CHEMICAL OF POTENTIAL CONCERN		EPC (mg/kg)		Chronic Daily Intake Values						Noncancer Hazard Quotients						Cancer Risks					
				Noncarcinogenic			Carcinogenic			Dermal Contact	Ingestion	Inhalation	Total	% of Total	Dermal Contact	Ingestion	Inhalation	Total	% of Total		
				Dermal	Ingestion	Inhalation	Dermal	Ingestion	Inhalation												
Arsenic Barium Lead	5.4E+00	1.0E-06	2.6E-06	8.1E-10	3.7E-07	9.4E-07	2.9E-10	3.5E-03	8.8E-03	ND	1.2E-02	94.3	5.6E-07	1.4E-06	4.4E-09	2.0E-06	100.0				
	8.9E+01	0.0E+00	4.5E-05	1.4E-08	0.0E+00	1.6E-05	5.0E-09	ND	6.5E-04	9.9E-05	7.4E-04	5.7	ND	ND	ND	ND	0.0				
	1.7E+02	0.0E+00	3.5E-04	1.1E-07	0.0E+00	1.2E-04	3.8E-08	ND	ND	ND	ND	0.0	ND	ND	ND	ND	0.0				
Total Risks:																					
								3.5E-03	9.5E-03	9.9E-05	1.3E-02	100.0	5.6E-07	1.4E-06	4.4E-09	2.0E-06	100.0				

Notes:

1. Adsorbed doses were calculated for dermal contact with the medium, and intakes were calculated for ingestion or inhalation of a medium.
2. For noncarcinogenic effects, the chronic daily intake (CDI) is averaged over the exposure period; whereas for carcinogenic effects, the CDI is averaged over the lifetime (i.e., 70 years). Therefore, the difference between the CDI for noncarcinogenic vs. carcinogenic effects is due to the different methods of time weighting used to estimate the value.
3. A noncancer risk estimate (HQ) of greater than 1 indicates the potential of noncancer effects (e.g., liver disease) to occur in humans exposed at an assumed level and duration to a contaminated medium. A cancer risk level of greater than 1.0E-04 (i.e., one in ten thousand) is above the U.S.EPA's protective risk range for Superfund Sites.
4. Hazard quotient and cancer risks are unitless values which represent the probability of incurring an adverse health effect. These risk values are calculated using the following relationships:
 Hazard Quotient = Chronic Daily Intake / Reference Dose
 Cancer Risk = Chronic Daily Intake x Slope Factor

5. Hazard Quotients and cancer risks are summarized for applicable routes of exposure. Values for each route are summed to arrive at a total exposure pathway risk. The percentage of total risk is also shown for each compound. In some cases, risks were not determined (ND) because a reference dose or slope factor was not available. NA indicates the route is not applicable.

Legend:

EPC = Exposure Point Concentration

Table 8

EXPOSURE AND HEALTH RISK ESTIMATES
Reasonable Maximum Exposure

Pechiney Plastic Packaging, Inc. Site
 Des Moines, Iowa

Source Area: Former Drum Burial Area
 Medium: Soil - All Depths

Population: Construction Worker
 Land Use: Current Use Scenario

CHEMICAL OF POTENTIAL CONCERN	EPC (mg/kg)	Chronic Daily Intake Values						Noncancer Hazard Quotients						Cancer Risks						
		Noncarcinogenic			Carcinogenic			Dermal Contact	Ingestion	Inhalation	Dermal Contact	Ingestion	Inhalation	Total	% of Total	Dermal Contact	Ingestion	Inhalation	Total	% of Total
		Dermal	Ingestion	Inhalation	Dermal	Ingestion	Inhalation													
Arsenic	5.4E+00	8.0E-07	1.0E-05	8.0E-07	1.1E-08	1.5E-07	1.1E-08	2.7E-03	3.4E-02	ND	2.7E-03	3.4E-02	ND	3.7E-02	75.2	1.7E-08	2.2E-07	1.7E-07	4.1E-07	100.0
Barium	9.2E+01	0.0E+00	1.7E-04	1.4E-05	0.0E+00	2.5E-06	2.0E-07	ND	2.5E-03	9.6E-03	ND	2.5E-03	9.6E-03	1.2E-02	24.8	ND	ND	ND	ND	0.0
Lead	7.2E+02	0.0E+00	1.3E-03	1.1E-04	0.0E+00	1.9E-05	1.5E-06	ND	ND	ND	ND	ND	ND	ND	0.0	ND	ND	ND	ND	0.0
		Total Risks:						2.7E-03	3.6E-02	9.6E-03	2.7E-03	3.6E-02	9.6E-03	4.9E-02	100.0	1.7E-08	2.2E-07	1.7E-07	4.1E-07	100.0

Notes:

1. Adsorbed doses were calculated for dermal contact with the medium, and intakes were calculated for ingestion or inhalation of a medium.
2. For noncarcinogenic effects, the chronic daily intake (CDI) is averaged over the exposure period; whereas for carcinogenic effects, the CDI is averaged over the lifetime (i.e., 70 years). Therefore, the difference between the CDI for noncarcinogenic vs. carcinogenic effects is due to the different methods of time weighting used to estimate the value.
3. A noncancer risk estimate (HQ) of greater than 1 indicates the potential of noncancer effects (e.g., liver disease) to occur in humans exposed at an assumed level and duration to a contaminated medium. A cancer risk level of greater than 1.0E-04 (i.e., one in ten thousand) is above the U.S. EPA's protective risk range for Superfund Sites.
4. Hazard quotient and cancer risks are unitless values which represent the probability of incurring an adverse health effect. These risk values are calculated using the following relationships:
 Hazard Quotient = Chronic Daily Intake / Reference Dose
 Cancer Risk = Chronic Daily Intake x Slope Factor

5. Hazard Quotients and cancer risks are summarized for applicable routes of exposure. Values for each route are summed to arrive at a total exposure pathway risk. The percentage of total risk is also shown for each compound. In some cases, risks were not determined (ND) because a reference dose or slope factor was not available. NA indicates the route is not applicable.

Legend:

EPC = Exposure Point Concentration

Table 9

EXPOSURE AND HEALTH RISK ESTIMATES
Maximum Reasonable Exposure

Pechiney Plastic Packaging, Inc. Site
Des Moines, Iowa

Source Area: Shallow Groundwater
Medium: Groundwater On PPPI Property

Population: Hypothetical Industrial Worker (see note 1 below)
Land Use: Hypothetical Future Land Use Scenario

CHEMICAL OF POTENTIAL CONCERN	EPC (mg/L)	Chronic Daily Intake Values						Noncancer Hazard Quotients					Cancer Risks				
		Noncarcinogenic			Carcinogenic			Dermal Contact	Ingestion	Inhalation	Total	% of Total	Dermal Contact	Ingestion	Inhalation	Total	% of Total
		Dermal	Ingestion	Inhalation	Dermal	Ingestion	Inhalation										
Benzene	3.4E-02	NA	3.3E-04	NA	NA	1.2E-04	NA	NA	1.1E-01	NA	1.1E-01	1.0	NA	6.5E-06	NA	6.5E-06	0.4
Arsenic	3.3E-01	NA	3.2E-03	NA	NA	1.1E-03	NA	NA	1.1E+01	NA	1.1E+01	98.1	NA	1.7E-03	NA	1.7E-03	99.6
Barium	6.6E-01	NA	6.5E-03	NA	NA	2.3E-03	NA	NA	9.3E-02	NA	9.3E-02	0.9	NA	ND	NA	ND	0.0
Lead	1.2E-02	NA	1.2E-04	NA	NA	4.2E-05	NA	NA	ND	NA	ND	0.0	NA	ND	NA	ND	0.0
Total Risks:								0.0E+00	1.1E+01	0.0E+00	1.1E+01	100.0	0.0E+00	1.7E-03	0.0E+00	1.7E-03	100.0

Notes:

- This table summarizes the potential risks for hypothetical employees if groundwater from the shallow aquifer on the PPPI property was used as a drinking water source. This is provided for informational purposes, because such a scenario is considered highly unlikely. It was assumed for purposes of this scenario that hypothetical employee will consume on a daily basis all of their drinking water from the most contaminated portion of the shallow aquifer on the property for twentyfive (25) years.
- Absorbed doses were calculated for dermal contact with the medium, and intakes were calculated for ingestion or inhalation of a medium.
- For noncarcinogenic effects, the chronic daily intake (CDI) is averaged over the exposure period; whereas for carcinogenic effects, the CDI is averaged over the lifetime (i.e., 70 years). Therefore, the difference between the CDI for noncarcinogenic vs. carcinogenic effects is due to the different methods of time weighting used to estimate the value.
- A noncancer risk estimate (HQ) of greater than 1 indicates the potential of noncancer effects (e.g., liver disease) to occur in humans exposed at an assumed level and duration to a contaminated medium. A cancer risk level of greater than 1.0E-04 (i.e., one in ten thousand) is above the U.S. EPA's protective risk range for Superfund Sites.
- Hazard quotient and cancer risks are unitless values which represent the probability of incurring an adverse health effect. These risk values are calculated using the following relationships:
Hazard Quotient = Chronic Daily Intake / Reference Dose
Cancer Risk = Chronic Daily Intake x Slope Factor
- Hazard Quotients and cancer risks are summarized for applicable routes of exposure. Values for each route are summed to arrive at a total exposure pathway risk. The percentage of total risk is also shown for each compound. In some cases, risks were not determined (ND) because a reference dose or slope factor was not available. NA indicates the route is not applicable.

Legend:

EPC = Exposure Point Concentration